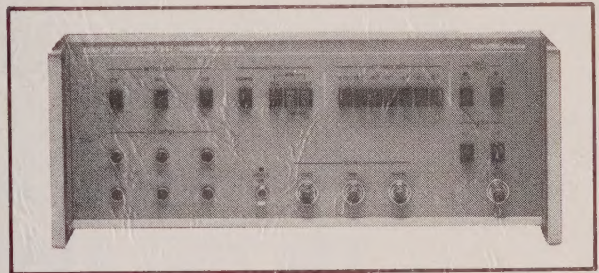


Instruction Manual

Model 4651A Bit Error Rate Test Set Transmitter Maintenance Manual



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MODEL NO. _____

SERIAL NO. _____

MODEL 4651A BIT ERROR RATE TEST SET TRANSMITTER MAINTENANCE MANUAL

*In all correspondence concerning this publication, refer to **35G031A***

Second Edition

August, 1983

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OVERVIEW

0.1 INTRODUCTION

The Scientific-Atlanta Model 4651A BERTS Transmitter is supplied with two manuals: the Operator's and the Maintenance. This Maintenance manual provides technical information such as the theory of operation, service maintenance procedures, parts listings, printed circuit board layouts and schematics, and is designed to be used in conjunction with the Operator's manual. However, some of the more frequently referred to information (from the Operator's manual) is reprinted in this Overview section in case the Operator's manual is not readily available.

NOTE

The information in this manual is intended
for use by an experienced technician only.

Although this unit is very similar to the Model 4651 Transmitter, there are several differences. Please be sure that you have the correct manual for your unit.

0.2 TECHNICAL CHARACTERISTICS

Model 4651A BERTS Transmitter

Internal Clock	
Frequency:	44.736 MHz (DS3) crystal source
Stability:	±20 ppm, 0 to 20 years, 0° to 50°C
External Clock	
Input Connector:	BNC type
Impedance:	75 ohms, ac coupled

Model 4651A BERTS Transmitter - continued

Frequency:	40 MHz to 46 MHz
Amplitude:	1.0 volt peak-to-peak
Interface:	ECL compatible
OUTPUT - CLOCK	
Connector:	BNC type
Impedance:	75 ohms, ac coupled
Amplitude:	1.0 volt peak-to-peak
Frequency:	CLOCK-INT Switch depressed = 44.736 MHz CLOCK-EXT Switch depressed = External Clock frequency Both INT and EXT Switches released = No output clock
OUTPUT - DATA	
Connector:	BNC type
Impedance:	75 ohms
Amplitude:	Internally selectable to TTL, ECL, or 1.0 volt peak-to-peak (bipolar)
Frequency:	INT or EXT clock, switch selectable
OUTPUT - UNIPOLAR DATA	
Framing:	DS3 frame structure may be superimposed on the selected data pattern or disabled
Format:	Unipolar, non-return to zero (NRZ)
Interface:	TTL compatible; will drive 50 or 75 ohm termination with one pulse per superframe
OUTPUT - M-SYNC	
Format:	Unipolar signal
Interface:	TTL compatible; will drive 50 or 75 ohm termination
OUTPUT - B3ZS	
Connector:	Six (6) independent WECO 440 type
Impedance:	75 ohms
Framing:	DS3 frame structure (when enabled) superimposed on selected data pattern

Model 4651A BERTS Transmitter - continued

Format:	Coded in B3ZS (bipolar) format, with choice of 3 output waveforms: HIGH = 1.82($\pm$0.5) volt peak-to-peak LOW = 0.37($\pm$0.1) volt peak-to-peak DSX-3 = processed version of HIGH waveform, simulating the HIGH output through 450 feet of type 728A cable
Pulse Characteristics Width: Rise/fall: Over/undershoot: Data Patterns* PRBS: 1111: 0000: BLUE: Error Insertion:	11.2($\pm$1.1) nS (at half amplitude) 4.5($\pm$1.5) nS Less than 10% of pulse amplitude Pseudo-random bit sequence of 32767 bits Continuous ...111... Continuous ...000... Continuous ...10101... selected by pressing both the 1111 and 0000 button Single Errors: by pressing the single error button, single bit (and parity if framing is selected) or bipolar violation errors may be inserted into the output data Constant Errors: bit (and parity if framing is selected) errors at a fixed bit error rate can be inserted by pressing one of the Bit Error Rate buttons. Rates of 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6}, 10^{-7}, and 10^{-8} are available.

*Note that all four data patterns are available with or without the DS3 framing structure. Framing is selected when the FRAMING switch is in and is de-selected when it is out.

Model 4651A HERTS Transmitter - continued

GENERAL FEATURES	
Power Supply:	Operates from either line voltage of 115/220V ac ($\pm 10\%$), 50 to 60 Hz, or station battery of -22V to -60V dc with positive ground.
Power Dissipation:	50 Watts
Weight:	7.7 kilograms (17 pounds)
Dimensions:	33 cm W x 38.1 cm D x 13.3 cm H (13 in. W x 15 in. D x 5.25 in. H)
Temperature:	Operating: 0° to +50°C Storage: -20° to +50°C

0.3 FRONT AND REAR PANEL CONFIGURATIONS

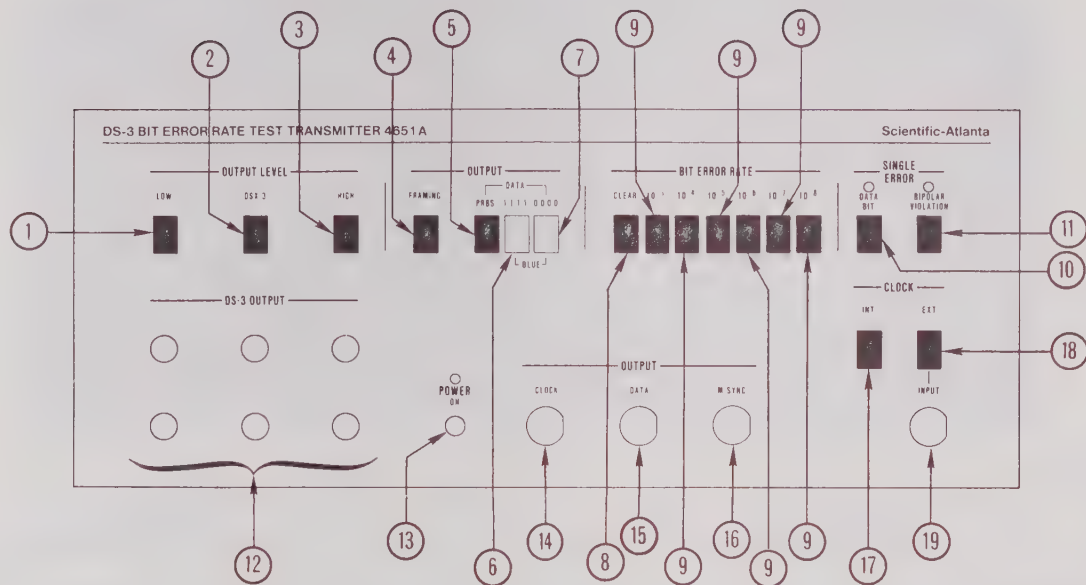


Figure 0.1. Model 4651A BERTS Transmitter, Front Panel Controls and Indicators

1. (Output Level) Low Switch
2. (Output Level) DSX-3 Switch
3. (Output Level) High Switch
4. Framing Switch
5. PRBS Switch
6. 1111 Switch
7. 0000 Switch
- 6,7. Blue
8. (Bit Error Rate) Clear Switch
9. (Bit Error Rate) 10⁻³, 10⁻⁴, 10⁻⁵, 10⁻⁶, 10⁻⁷, 10⁻⁸ Switches
10. (Single Error) Data Bit Switch
11. (Single Error) Bipolar Violation Switch
12. DS3 Output Connectors
13. Power On Switch
14. (Output) Clock Connector
15. (Output) Data Connector
16. (Output) M-Sync Connector
17. (Clock) INT Switch
18. (Clock) EXT Switch
19. (Input) Clock Connector

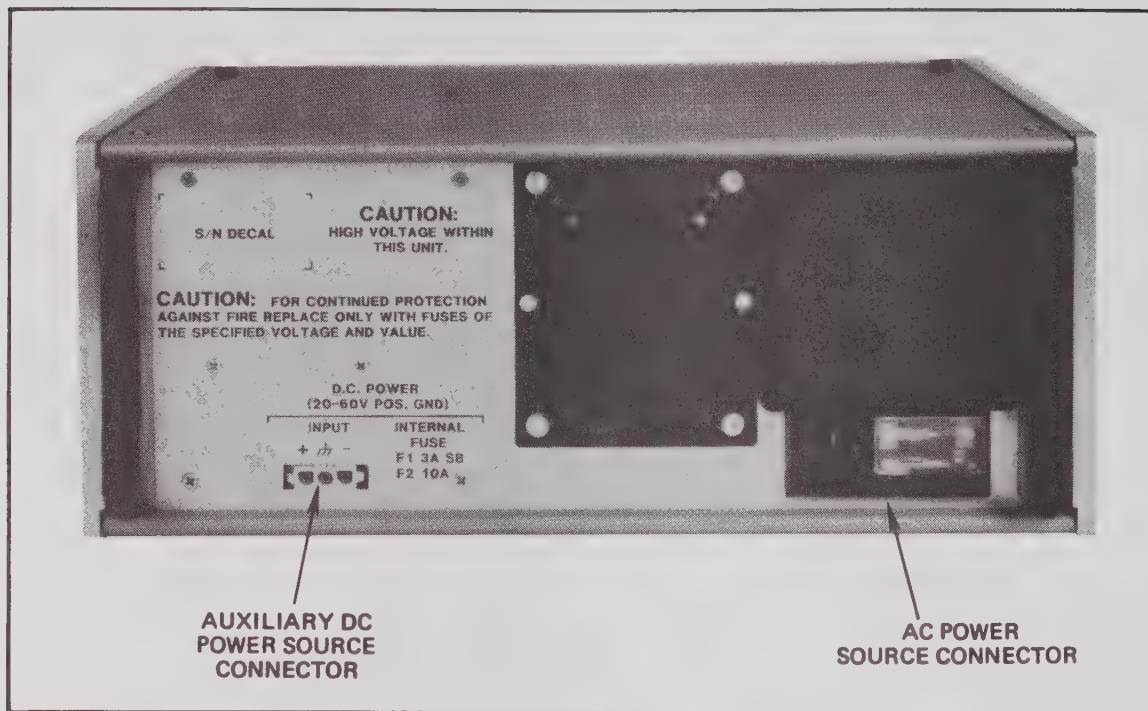


Figure 0.2. Model 4651A BERTS Transmitter, Rear Panel Features

CHAPTER 4 THEORY OF OPERATION

4.1 GENERAL

Theory of operation for the Model 4651A Bit Error Rate Test Set system is presented in two parts. Part One describes the power supply while Part Two describes features and functions. The power supply is described in a separate section because it operates independently from the other circuits.

The Model 4651A generates Bell System DS3 formatted digital signal in either a bipolar with 3-zero substitution arrangement or a non-return to zero (NRZ) arrangement with separate clock and data lines. Figure 4.1 outlines key features of the DS3 signal format. Within this format, the transmitter can send a data pattern of all 1's, all 0's, alternate 1's and 0's (...10101...), or a repeating pseudo random bit sequence (PRBS) of 32767 bits. The selected data pattern alone can be sent by disabling the framing bits. The receiver (a Model 4652A), in turn, is capable of determining the presence or absence of a framing pattern and locking onto a PRBS or alternating 1's and 0's pattern. If the PRBS is detected, bit errors are measured, while the ...10101... pattern results in a "BLU" signal display. If framing is present, parity errors are detected and measured. This feature makes it possible to measure error rates on live traffic.

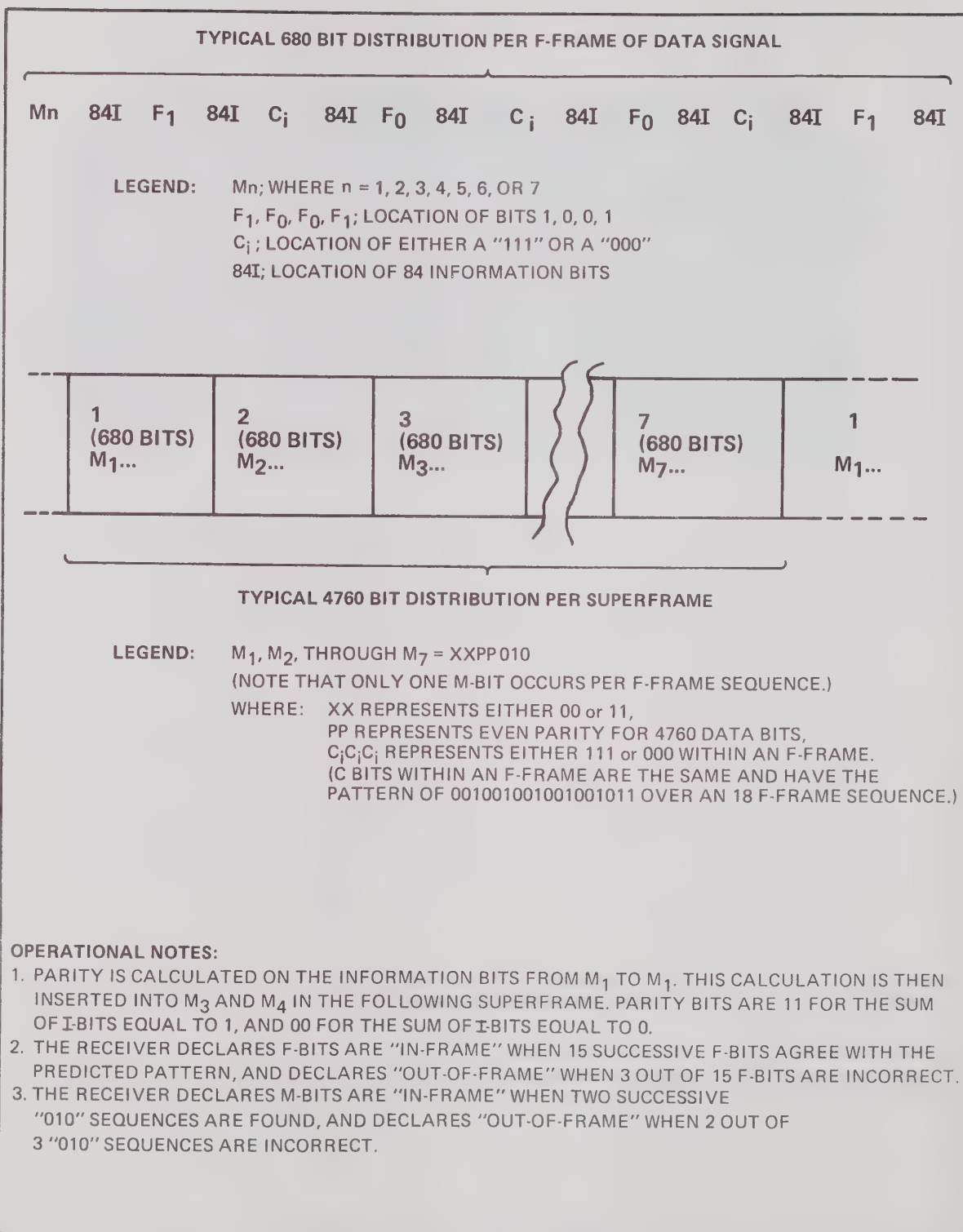


Figure 4.1. DS3 Format

4.2 MODEL 4651A DC SUPPLY

Source power for the Model 4651A may be supplied from a 115V/220V, 50/60 Hz ac line and/or from a -22V to -60V DC, positive ground, Station Battery connection. Either source can provide the internal dc voltage required to operate the Pulse Width Modulator power supply circuits. The Pulse Width Modulator provides a switching-type power source that has high efficiency, low weight, and versatile operating voltages. If both ac and dc sources are connected to their respective inputs, the ac is transformer reduced and rectified to approximately -40 volts dc. The two dc sources are "diode-ORed" to allow the highest source potential to drive the power supply circuits.

A. AC/DC INPUT POWER SOURCE

Figure 4.2 is a block diagram of input power source distribution for the Model 4651A BERTS Transmitter. The rear panel schematic is shown in Figure 7.13. Both sides of the ac power source (hot and neutral) are switch interrupted and the third wire safety ground is connected directly to the chassis. The applied ac is reduced through transformer T1 to approximately 32 volts ac RMS which is rectified by diode bridge CR3 on the Rectifier and Filter Assembly PCB. The output voltage from CR3 is a nominal -40V dc which is filtered by capacitors C4 and C5 and applied to one terminal of diode bridge CR2.

If a Station Battery dc source of -22V to -60V (positive ground) is applied to the rear panel DC INPUT connector (J1), both the source and the equipment are fuse protected (F1 and F2 on the Rectifier and Filter Assembly PCB). The negative source line is interrupted by contacts of the front panel POWER ON switch. When closed, the switch contacts apply the battery source voltage through a current limiting circuit and a filter network of L1, C1, C2, and C3 to a terminal of diode bridge CR2. The filter network removes induced noise components and transients from reflecting into the Station Battery source. A diode, CR1, is part of this filtering network and also provides protection should the Station Battery source polarity be accidentally reversed.

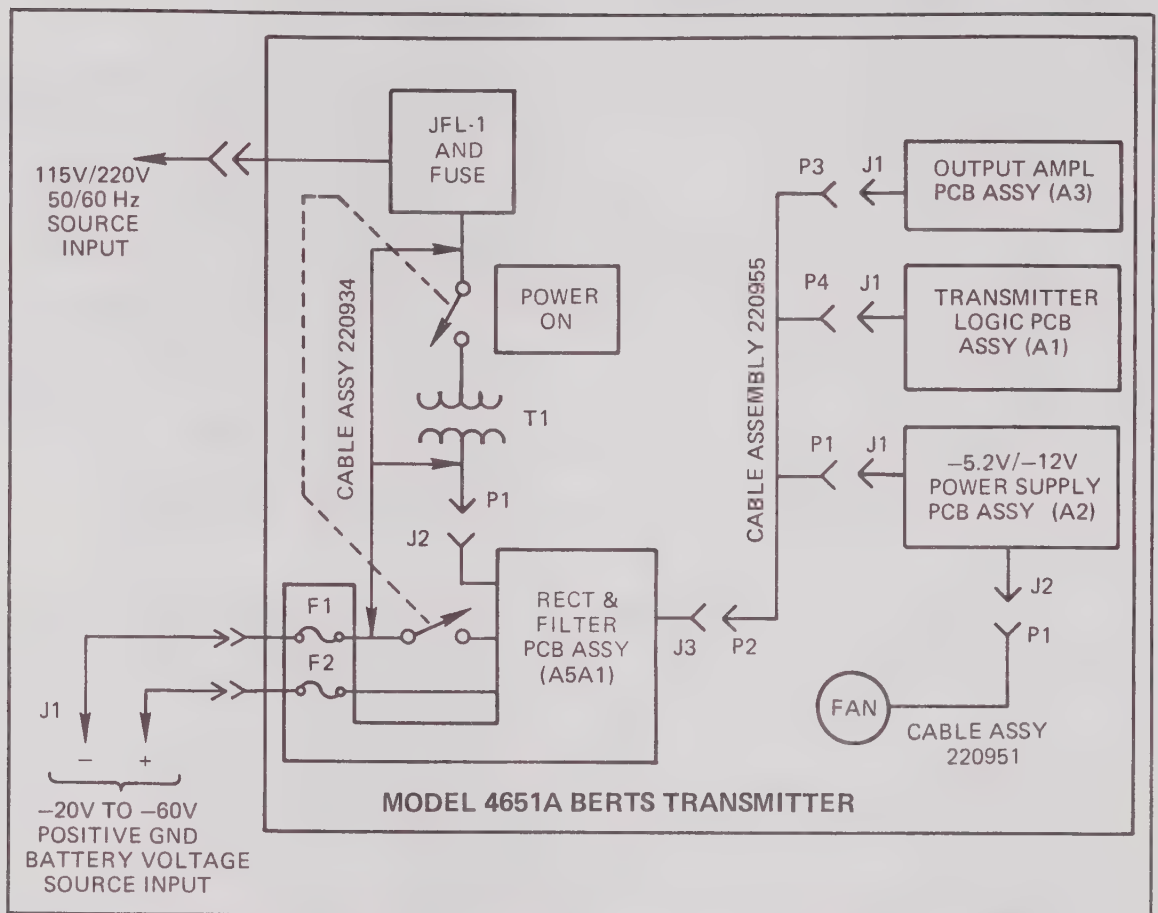


Figure 4.2. Input Power Source Distribution, Block Diagram

The two dc sources are connected at specific terminals of diode bridge CR2. The source having the larger potential will be passed by its respective diode in the bridge (CR2). At the same time, CR2 will reverse bias the alternate source from conduction. In this manner, the two power sources are diode OR'ed, the larger potential supplying operating power, and the lower potential in ready reserve if needed.

B. -5.2V/-12V DC POWER SUPPLY PRINTED CIRCUIT BOARD ASSEMBLY

General. The -5.2V/-12V DC Power Supply PCB uses a pulse width modulation circuit where varying the duty cycle of a fixed frequency pulse stream produces an adjustable regulated dc voltage output. The output is sensed and

fed back into the pulse width modulator which controls pulse width as needed to maintain a constant voltage. A block diagram of the -5.2V/-12V DC Power Supply PCB Assembly is shown in Figure 4.3. Components U1 and U3 each contain all the active circuitry necessary to implement a pulse width modulator except for the power switching transistor. Components used with U1 or U3 are necessary to set the desired operating frequency, provide voltage adjustment, or other supporting functions. Other circuitry included on the PCB assembly provide for overvoltage protection, voltage regulation, and feedback control. In summary, a -22V to -60V dc input is switched through power transistors under control of a pulse width modulator to produce regulated -5.2V and -12.0V dc source supplies.

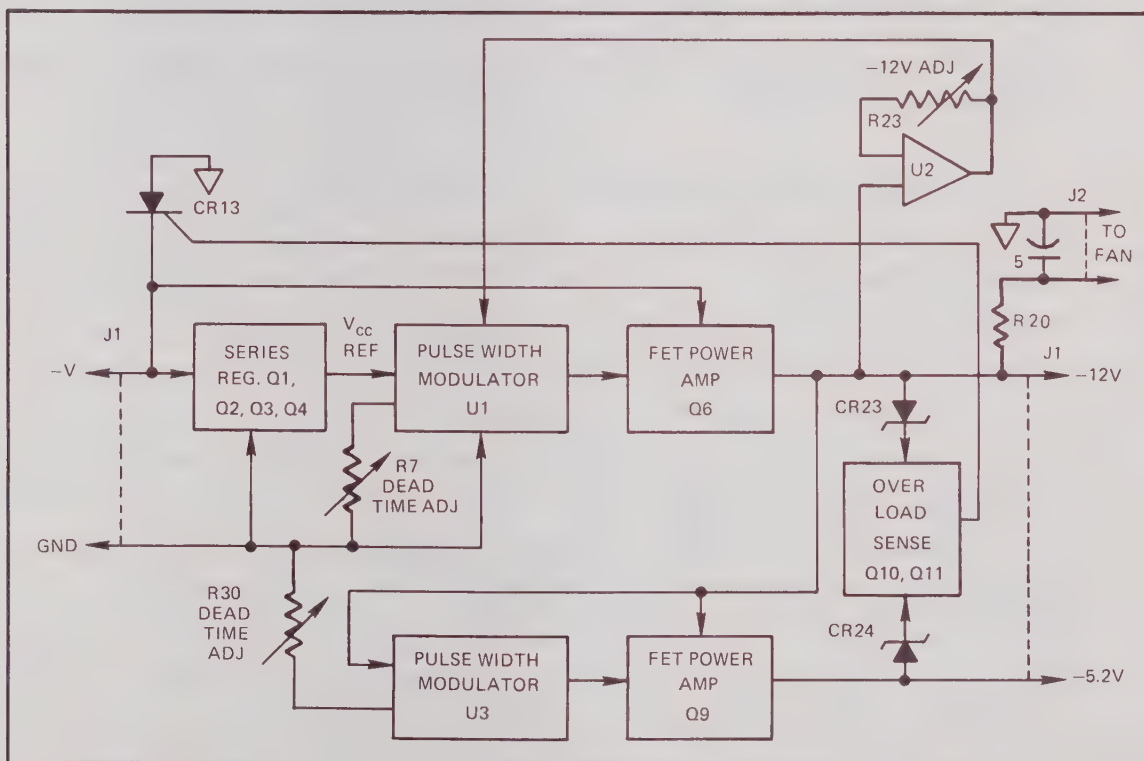


Figure 4.3. The -5.2V/-12V DC Power Supply PCB Assembly, Block Diagram

Series Regulator Circuit. The schematic diagram for the -5.2V/-12V DC Power Supply PCB Assembly is shown in Figure 7.5. A regulated voltage is required to operate a pulse width modulator circuit and the applied source voltage of -22V to -60V must be regulated to supply a nominal 12V to pulse width

modulator U1. Transistors Q1 through Q4 and associated components are connected as a series regulator producing a 12V output for U1. Note that the "-V" input in common to the series regulator circuit and the pulse width modulator and the regulator output (measured at test point TP1), will be +12 volts higher than the applied -22V to -60V input and not referenced to ground. The diode CR5 provides reverse voltage protection, and zener diode CR6 provides overvoltage protection for U1.

-12V DC Switching Regulator. All regulated dc sources produced by a Model 4651A power supply, use an SG3524 (or equivalent) Pulse Width Modulator component. A typical data sheet specifying the parameters of the SG3524 is provided in Figure 4.4 (8 sheets) and should describe the internal operation. The following description details the external component connections and their respective interaction with the Pulse Width Modulator (hereafter referred to as the PWM).

The PWM provides an internally stabilized reference voltage at pin 16 which is used as reference for "Dead Time Adjust" as well as several bias voltages. The "Dead Time Adjust" corresponds to the time when the PWM outputs are forced OFF. This is required in push-pull arrangements to guarantee both outputs cannot be ON simultaneously. When used as a single-ended drive (see Figure 7.5), "Dead Time Adjust" establishes the maximum output current by setting the maximum duty cycle. Variable resistor R7 (Dead Time Adjust for U1) is properly set by operating the -5.2V/-12V Power Supply PCB into a full load with a minimum input voltage (-22V dc). Variable resistor R7 is adjusted with minimum input voltage (-22V dc) clockwise to a point where the reference voltage (at U1, pin 16) starts going out-of-regulation and then is reversed two turns counterclockwise. The reference voltage is also divided by resistors R10 and R11 to bias the unused "plus" input of the internal amplifier (U1, pin 2) to an acceptable midrange point. The reference voltage is divided by resistors R16 and R17 to establish the current limit reference (U1, pin 5) to approximately 3.5 Amperes. Components R8 and C6 will hold the PWM outputs OFF momentarily on initial power-up to allow voltages to stabilize before the PWM begins to regulate.

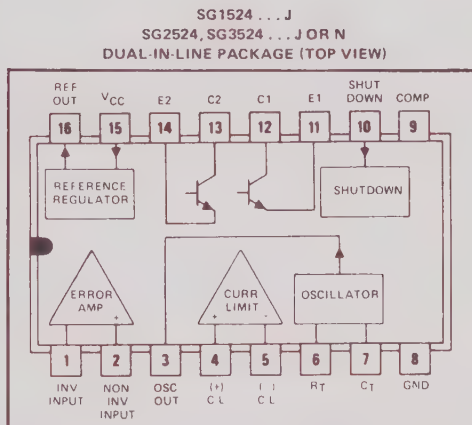
LINEAR INTEGRATED CIRCUITS REGULATING PULSE WIDTH MODULATORS

BULLETIN NO. DLS 12495, APRIL 1977

- Complete PWM Power Control Circuitry
- Uncommitted Outputs for Single-Ended or Push-Pull Applications
- Low Standby Current . . . 8 mA Typ
- Interchangeable With Silicon General SG1524, SG2524, and SG3524, Respectively

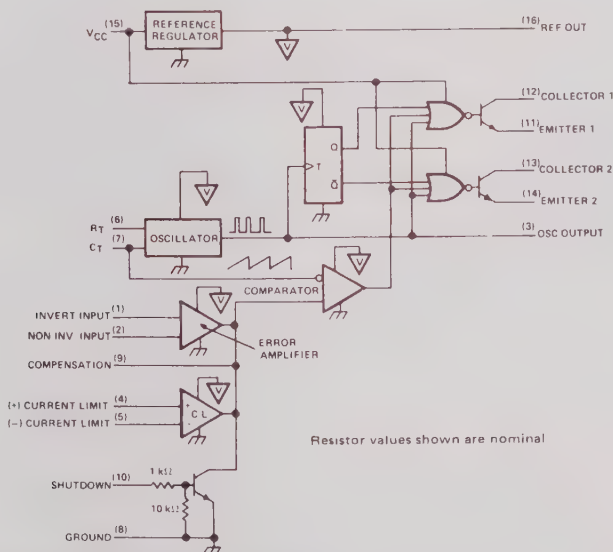
description

The SG1524, SG2524, and SG3524 incorporate on single monolithic chips all the functions required in the construction of a regulating power supply, inverter, or switching regulator. They can also be used as the control element for high-power-output applications. The SG1524 family was designed for switching regulators of either polarity, transformer-coupled dc-to-dc converters, transformerless voltage doublers, and polarity converter applications employing fixed-frequency, pulse-width-modulation techniques. The complementary output allows either single-ended or push-pull application. Each device includes an on-chip regulator, error amplifier, programmable oscillator, pulse-steering flip-flop, two uncommitted pass transistors, a high-gain comparator, and current-limiting and shut-down circuitry.



The SG1524 is characterized for operation over the full military temperature range of -55°C to 125°C . The SG2524 and SG3524 are characterized for operation from 0°C to 70°C .

functional block diagram



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Figure 4.4. Pulse Width Modulator SG3524, Data Sheets (Sheet 1 of 8)

TYPES SG1524, SG2524, SG3524

REGULATING PULSE WIDTH MODULATORS

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply Voltage, V_{CC} (See Notes 1 and 2)	40 V
Collector Output Current	100 mA
Reference Output Current	50 mA
Current Through C_T Terminal	-5 mA
Continuous Total Dissipation at (or below) 25°C Free-Air Temperature (See Note 3)	1000 mW
Operating Free-Air Temperature Range: SG1524	-55°C to 125°C
SG2524, SG3524	0°C to 70°C
Storage Temperature Range	-65°C to 150°C

NOTES: 1. All voltage values are with respect to network ground terminal.

2. The reference regulator may be bypassed for operation from a fixed 5-volt supply by connecting the V_{CC} and reference output pins both to the supply voltage. In this configuration the maximum supply voltage is 6 volts.

3. For operation above 25°C free-air temperature, see Dissipation Derating Curves, page 124.

recommended operating conditions

	SG1524		SG2524, SG3524		UNIT
	MIN	MAX	MIN	MAX	
Supply voltage, V_{CC}	8	40	8	40	V
Reference output current	0	50	0	50	mA
Current thru C_T terminal	-0.03	-2	-0.03	-2	mA
Timing resistor, R_T	1.8	100	1.8	100	k Ω
Timing capacitor, C_T	0.001	0.1	0.001	0.1	μ F
Operating free-air temperature	-55	125	0	70	°C

electrical characteristics over recommended operating free-air temperature range, $V_{CC} = 20$ V, $f = 20$ kHz (unless otherwise noted)

reference section

PARAMETER	TEST CONDITIONS [†]	SG1524			SG2524			SG3524			UNIT
		MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	
Output voltage		4.8	5	5.2	4.8	5	5.2	4.6	5	5.4	V
Input regulation	$V_{CC} = 8$ to 40 V		10	20		10	20		10	30	mV
Ripple rejection	$f = 120$ Hz		66			66			66		dB
Output regulation	$I_O = 0$ to 20 mA		20	50		20	50		20	50	mV
Output voltage change with temperature	$T_A = \text{MIN to MAX}$		0.6	2		0.3	1		0.3	1	%
Short-circuit output current §	$V_{ref} = 0$		100			100			100		mA

[†] For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

[‡] All typical values except output voltage change with temperature are at $T_A = 25^\circ\text{C}$.

§ Duration of the short-circuit should not exceed one second

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Figure 4.4. Pulse Width Modulator SG3524, Data Sheets (Sheet 2 of 8)

TYPES SG1524, SG2524, SG3524 REGULATING PULSE WIDTH MODULATORS

electrical characteristics over recommended operating free-air temperature range, $V_{CC} = 20\text{ V}$, $f = 20\text{ kHz}$ (unless otherwise noted)

error amplifier section

PARAMETER	TEST CONDITIONS	SG1524, SG2524			SG3524			UNIT
		MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX [†]	
Input offset voltage	$V_{IC} = 2.5\text{ V}$		0.5	5		2	10	mV
Input bias current	$V_{IC} = 2.5\text{ V}$		2	10		2	10	μA
Open-loop voltage amplification		72	80		60	80		dB
Common-mode input voltage range	$T_A = 25^\circ\text{C}$	1.8 to 3.4			1.8 to 3.4			V
Common-mode rejection ratio			70			70		dB
Unity-gain bandwidth			3			3		MHz
Output swing	$T_A = 25^\circ\text{C}$	0.5		3.8	0.5		3.8	V

oscillator section

PARAMETER	TEST CONDITIONS [†]	MIN	TYP [‡]	MAX	UNIT
Frequency	$C_T = 0.001\text{ }\mu\text{F}$, $R_T = 2\text{ k}\Omega$		450		kHz
Standard deviation of frequency §	All values of voltage, temperature, resistance, and capacitance constant		5		%
Frequency change with voltage	$V_{CC} = 8\text{ to }40\text{ V}$, $T_A = 25^\circ\text{C}$			1	%
Frequency change with temperature	$T_A = \text{MIN to MAX}$			2	%
Output amplitude at pin 3			3.5		V
Output pulse width at pin 3	$C_T = 0.01\text{ }\mu\text{F}$		0.5		μs

comparator section

PARAMETER	TEST CONDITIONS	MIN	TYP [‡]	MAX	UNIT
Maximum duty cycle, each output		45			%
Input threshold voltage at pin 9	Zero duty cycle		1		V
	Maximum duty cycle		3.5		
Input bias current			-1		μA

current limiting section

PARAMETER	TEST CONDITIONS	SG1524, SG2524			SG3524			UNIT
		MIN	TYP [‡]	MAX	MIN	TYP [‡]	MAX	
Input voltage range (either input)		-0.7 to +1			-0.7 to +1			V
Sense voltage for 2-V output at pin 9	$V(\text{pin } 2) - V(\text{pin } 1) \geq 50\text{ mV}$, $T_A = 25^\circ\text{C}$	190	200	210	180	200	220	mV
Sense voltage	$T_A = \text{MIN to MAX}$		0.2			0.2		$\text{mV}/^\circ\text{C}$

[†]For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

[‡]All typical values except for temperature coefficients are at $T_A = 25^\circ\text{C}$.

§ Standard deviation is a measure of the statistical distribution about the mean as derived from the formula $\sigma = \sqrt{\frac{\sum_{i=1}^N (X_i - \bar{X})^2}{N - 1}}$

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Figure 4.4. Pulse Width Modulator SG3524, Data Sheets (Sheet 3 of 8)

TYPES SG1524, SG2524, SG3524

REGULATING PULSE WIDTH MODULATORS

PRINCIPLES OF OPERATION

The SG1524[†] is a fixed-frequency pulse-width-modulation voltage-regulator control circuit. The regulator operates at a fixed frequency that is programmed by one timing resistor R_T and one timing capacitor C_T . R_T establishes a constant charging current for C_T . This results in a linear voltage ramp at C_T , which is fed to the comparator providing linear control of the output pulse width by the error amplifier. The SG1524 contains an on-board 5-volt regulator that serves as a reference as well as supplying the SG1524's internal regulator control circuitry. The internal reference voltage is divided externally by a resistor ladder network to provide a reference within the common-mode range of the error amplifier as shown in Figure 6, or an external reference may be used. The output is sensed by a second resistor divider network and the error signal is amplified. This voltage is then compared to the linear voltage ramp at C_T . The resulting modulated pulse out of the high-gain comparator is then steered to the appropriate output pass transistor (Q1 or Q2) by the pulse-steering flip-flop, which is synchronously toggled by the oscillator output. The oscillator output pulse also serves as a blanking pulse to assure both outputs are never on simultaneously during the transition times. The width of the blanking pulse is controlled by the value of C_T . The outputs may be applied in a push-pull configuration in which their frequency is half that of the base oscillator, or paralleled for single-ended applications in which the frequency is equal to that of the oscillator. The output of the error amplifier shares a common input to the comparator with the current-limiting and shut-down circuitry and can be overridden by signals from either of these inputs. This common point is also available externally and may be employed to control the gain of, or to compensate, the error amplifier, or to provide additional control to the regulator.

TYPICAL APPLICATION DATA

oscillator

The oscillator controls the frequency of the SG1524 and is programmed by R_T and C_T as shown in Figure 4.

$$f \approx \frac{1.15}{R_T C_T}$$

where R_T is in kilohms
 C_T is in microfarads
 f is in kilohertz

Practical values of C_T fall between 0.001 and 0.1 microfarad. Practical values of R_T fall between 1.8 and 100 kilohms. This results in a frequency range typically from 140 hertz to 500 kilohertz.

blanking

The output pulse of the oscillator is used as a blanking pulse at the output. This pulse width is controlled by the value of C_T as shown in Figure 5. If small values of C_T are required, the oscillator output pulse width may still be maintained by applying a shunt capacitance from pin 3 to ground.

synchronous operation

When an external clock is desired, a clock pulse of approximately 3 volts can be applied directly to the oscillator output terminal. The impedance to ground at this point is approximately 2 kilohms. In this configuration $R_T C_T$ must be selected for a clock period slightly greater than that of the external clock.

If two or more SG1524 regulators are to be operated synchronously, all oscillator output terminals should be tied together. The oscillator programmed for the minimum clock period will be the master from which all the other SG1524's operate. In this application, the $C_T R_T$ values of the slaved regulators must be set for a period approximately 10% longer than that of the master regulator. In addition, C_T (master) = 2 C_T (slave) to ensure that the master output pulse, which occurs first, has a wider pulse width and will subsequently reset the slave regulators.

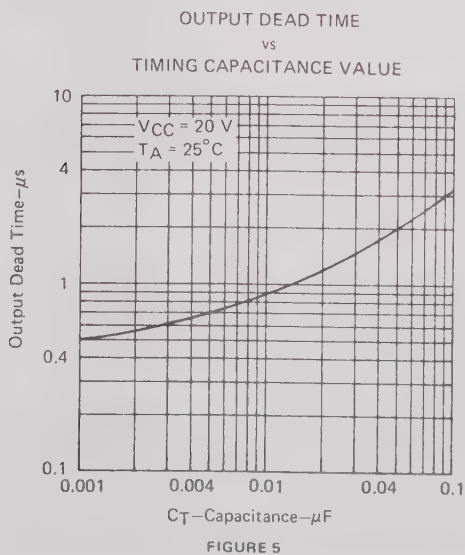
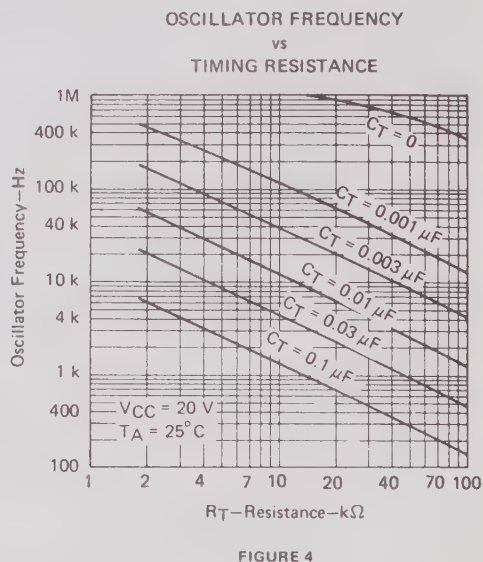
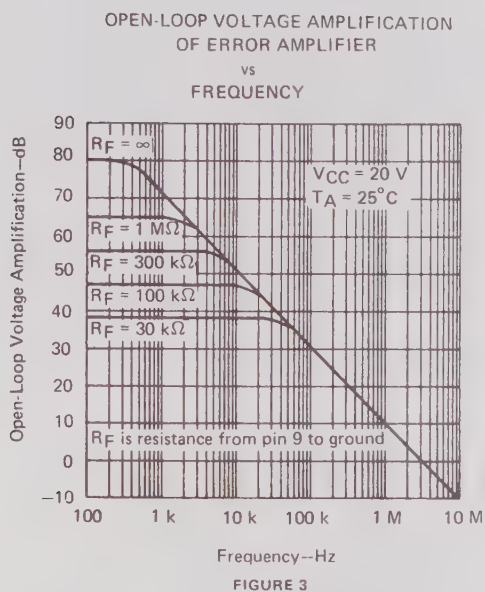
[†]Throughout these discussions, references to SG1524 apply also to SG2524 and SG3524.

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Figure 4.4. Pulse Width Modulator SG3524, Data Sheets (Sheet 5 of 8)

TYPES SG1524, SG2524, SG3524 **REGULATING PULSE WIDTH MODULATORS**

TYPICAL CHARACTERISTICS



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Figure 4.4. Pulse Width Modulator SG3524, Data Sheets (Sheet 6 of 8)

TYPES SG1524, SG2524, SG3524 REGULATING PULSE WIDTH MODULATORS

TYPICAL APPLICATION DATA

voltage reference

The 5-volt internal reference may be employed by use of an external resistor divider network to establish a reference within the error amplifiers common-mode voltage range (1.8 to 3.4 volts) as shown in Figure 6, or an external reference may be applied directly to the error amplifier. For operation from a fixed 5-volt supply, the internal reference may be bypassed by applying the input voltage to both the V_{CC} and V_{REF} terminals. In this configuration, however, the input voltage is limited to a maximum of 6 volts.

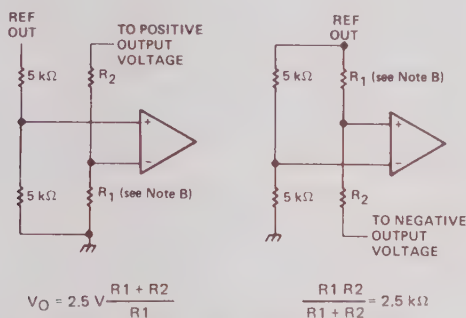


FIGURE 6—ERROR AMPLIFIER BIAS CIRCUITS

error amplifier

The error amplifier is a differential-input transconductance amplifier. The output is available for dc gain control or ac phase compensation. The compensation node (pin 9) is a high-impedance node ($R_L = 5$ megohms). The gain of the amplifier is $A_V = (0.002 \Omega^{-1}) R_L$ and can easily be reduced from a nominal 10,000 by an external shunt resistance from pin 9 to ground. Refer to Figure 3 for data.

compensation

Pin 9, as discussed above, is made available for compensation. Since most output filters will introduce one or more additional poles at frequencies below 200 hertz, which is the pole of the uncompensated amplifier, introduction of a zero to cancel one of the output filter poles is desirable. This can best be accomplished with a series RC circuit from pin 9 to ground in the range of 50 kilohms and 0.001 microfarads. Other frequencies can be canceled by use of the formula $f \approx 1/RC$.

shut down circuitry

Pin 9 can also be employed to introduce external control of the SG1524. Any circuit that can sink 200 microamperes can pull the compensation terminal to ground and thus disable the SG1524.

In addition to constant-current limiting, pins 4 and 5 may also be used in transformer-coupled circuits to sense primary current and shorten an output pulse should transformer saturation occur. Pin 5 may also be grounded to convert pin 4 into an additional shutdown terminal.

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Figure 4.4. Pulse Width Modulator SG3524, Data Sheets (Sheet 7 of 8)

TYPES SG1524, SG2524, SG3524

REGULATING PULSE WIDTH MODULATORS

TYPICAL APPLICATION DATA

current limiting

A current-limiting sense amplifier is provided in the SG1524. The current-limiting sense amplifier exhibits a threshold of 200 millivolts and must be applied in the ground line since the voltage range of the inputs is limited to +1 volt to -0.7 volt. Caution should be taken to ensure the -0.7-volt limit is not exceeded by either input, otherwise damage to the device may result.

Fold-back current limiting can be provided with the network shown in Figure 7. The current-limit schematic is shown in Figure 8.

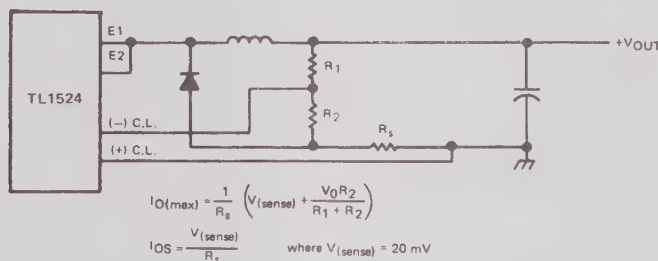


FIGURE 7—FOLDBACK CURRENT LIMITING FOR SHORTED OUTPUT CONDITIONS

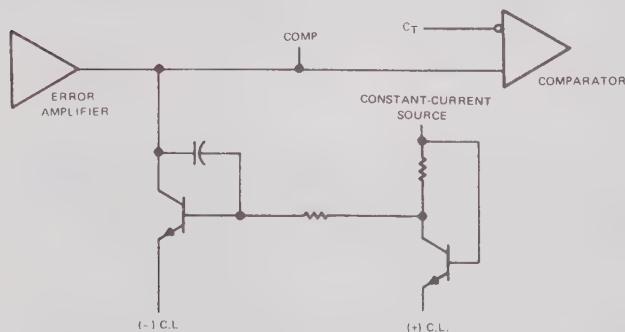


FIGURE 8—CURRENT-LIMIT SCHEMATIC

output circuitry

The SG1524 contains two identical n-p-n transistors the collectors and emitters of which are uncommitted. Each transistor has antisaturation circuitry that limits the current through that transistor to a maximum of 100 milliamperes for fast response.

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Figure 4.4. Pulse Width Modulator SG3524, Data Sheets (Sheet 8 of 8)

Components C10 and R14 set the PWM operating frequency at 40 kHz. Since the push-pull outputs of the PWM (U1, pins 11 and 14) are connected, the drive signal into the gate of transistor Q6 will also be 40 kHz. This driving signal can be monitored at test point TP3. Capacitor C11, connected to the PWM oscillator output (U1, pin 3), sets the minimum "Dead Time" to be greater than 0.5 microseconds. Resistor R13 biases the Shutdown Input (U1, pin 10) to a level where this function has no effect on the PWM operation. Components L1 and C8 filter the feedback signal applied to the Current Limit Sense (+C.L. Sense at U1, pin 4). If the Current Limit voltage developed across resistor R18 permits the voltage at -C.L. Sense (U1, pin 5) to exceed the voltage at +C.L. Sense (U1, pin 4), the PWM will not widen the pulse width to permit an increase in output current.

The collectors of the PWM output transistors are connected to the V_{CC} input source and the emitters are connected to drive the switching power transistor, Q6. Components R15, Q5, and CR9 increase the drive capability by providing rapid discharge of Q6 Gate capacitance. This effects a rapid turn-off as well as turn-on. The switching power transistor, Q6, is a FET device that is OFF (or open circuit) when V_{GS} equals 0V dc and ON (or closed circuit with 0.25 ohm max) when V_{GS} equals 10V dc. Diode CR10 protects Q6 from reverse voltage while network components L2, CR11, and R19 reduce ringing and over-voltage transients on the drain of Q6. The final -12V dc output is filtered by components L3, C17, L4, and C28 with diode CR12 providing a current path for the inductors when transistor Q6 is switched OFF.

Feedback control and frequency compensation for the PWM is made from a -12V dc source regulated by component U2 through transistor Q7 which provides level shifting. Variable resistor R23 is adjusted to produce the -12V dc output with components C16, R21, C18, R28, C9, and R12 providing frequency compensation. Components CR14 and R26 provide bias voltage for the "plus" input of component U2.

The separate -12V dc source to operate the fan is additionally filtered by components R20 and C15 to isolate the dc fan from the PWM. Diode CR23, transistor Q10, and connecting components provide an overvoltage protection

"crowbar" circuit. When the output voltage exceeds approximately 15V dc, transistor Q10 is switched ON and triggers the SCR diode CR13 to short the -V input and blow the appropriate input fuse. Resistor R25 is rated at 100-ohms, 3 Watts, and is provided to load the -12V dc supply when normal loads are removed. This is necessary because this switching power supply cannot operate into a zero load condition. Some loading must exist for the circuit to remain in regulation.

-5.2 DC Switching Regulator. In principle, the -5.2V dc switching regulator circuit operates identically to the -12V dc switching regulator circuit. There are several circuit changes to accommodate the different voltage range. The first difference to be noted is that the PWM U3 operates between the regulated -12V dc supply and ground rather than the floating supply used with PWM U1. The schematic (Figure 7.5) shows PWM U3, pin 15 is grounded and U3, pin 8 connects to the regulated -12V dc source. The operating frequency used by PWM U3 is set for 65 kHz, which drives the Gate of transistor Q9. This driving frequency can be monitored at test point TP3. The frequency is higher to simplify the necessary filtering for the -5.2V dc output which can exceed 3.0 Amperes when required.

The feedback component U4 drives transistor Q12 as a current source configuration into the PWM U3. Note that the PWM internal amplifiers are not used and the feedback signal is applied instead to the compensation input of the PWM. An overvoltage detector circuit using diode CR24, transistor Q11, and connected components is set to trigger at approximately 7 volts dc. This trigger signal also operates SCR diode CR13 to short the -V input and blow the appropriate input fuse if an overvoltage condition exists. Resistor R50, rated at 50-ohms, 3 Watts, loads the -5.2V dc supply when other loads are removed. This supply also requires some load to remain in regulation.

4.3 MODEL 4651A BERTS TRANSMITTER CIRCUITS

General. The Model 4651A BERTS Transmitter consists of the following major assemblies:

1. Rear panel and Power Wiring Harness
2. -5.2V/-12.0V DC Power Supply PCB Assembly (A2)
3. Output Amplifier PCB Assembly (A3)
4. Transmitter Logic PCB Assembly (A1)
5. Front Panel PCB Assembly (A4)

The Rear Panel, the Power Wiring Harness, and the -5.2/-12.0V DC Power Supply PCB Assembly have already been described in Section 4.2. The following paragraphs provide information for the remaining assemblies. The Output Amplifier assembly contains: (1) analog amplifiers for all front panel outputs, (2) a cable simulator for the DSX-3 OUTPUT LEVEL, and (3) the crystal reference oscillator. The Transmitter Logic assembly provides the logic circuits required to: (1) generate framing and data bit patterns as selected, (2) calculate and insert parity bits (when framing is selected), (3) introduce errors as set by switches, and (4) perform the B3ZS substitution. The Front Panel assembly interfaces the above circuits with the front panel control switches and indicators, and provides the necessary logic to select the transmitter operating modes. Figure 4.5 is a block diagram of a Model 4651A BERTS Transmitter showing the interconnections of circuit functions.

A. OUTPUT AMPLIFIER PCB ASSEMBLY (A3)

General. A block diagram of the Output Amplifier circuits is shown in Figure 4.6. The following descriptions identify the circuits in sections as shown in the block diagram. The schematic is shown in Figure 7.7.

1. Clock Circuits

The clock circuits consist of a 44.736 MHz oscillator module and ECL gates which select either the internal clock (or oscillator) or the external input from the front panel connector. Component U2 (a 10115 IC) is an ECL Line Receiver which is used to convert the oscillator output or the external CLOCK-INPUT signal to ECL levels at U2-14 and U2-15. An internal reference provided by U2 is voltage biased into midrange of logic 0 and logic 1. This reference output at U2-9 is buffered by line receiver U2A to provide a low impedance at U2-10 and U2-13. The ac coupled signal at U2-11 swings above and

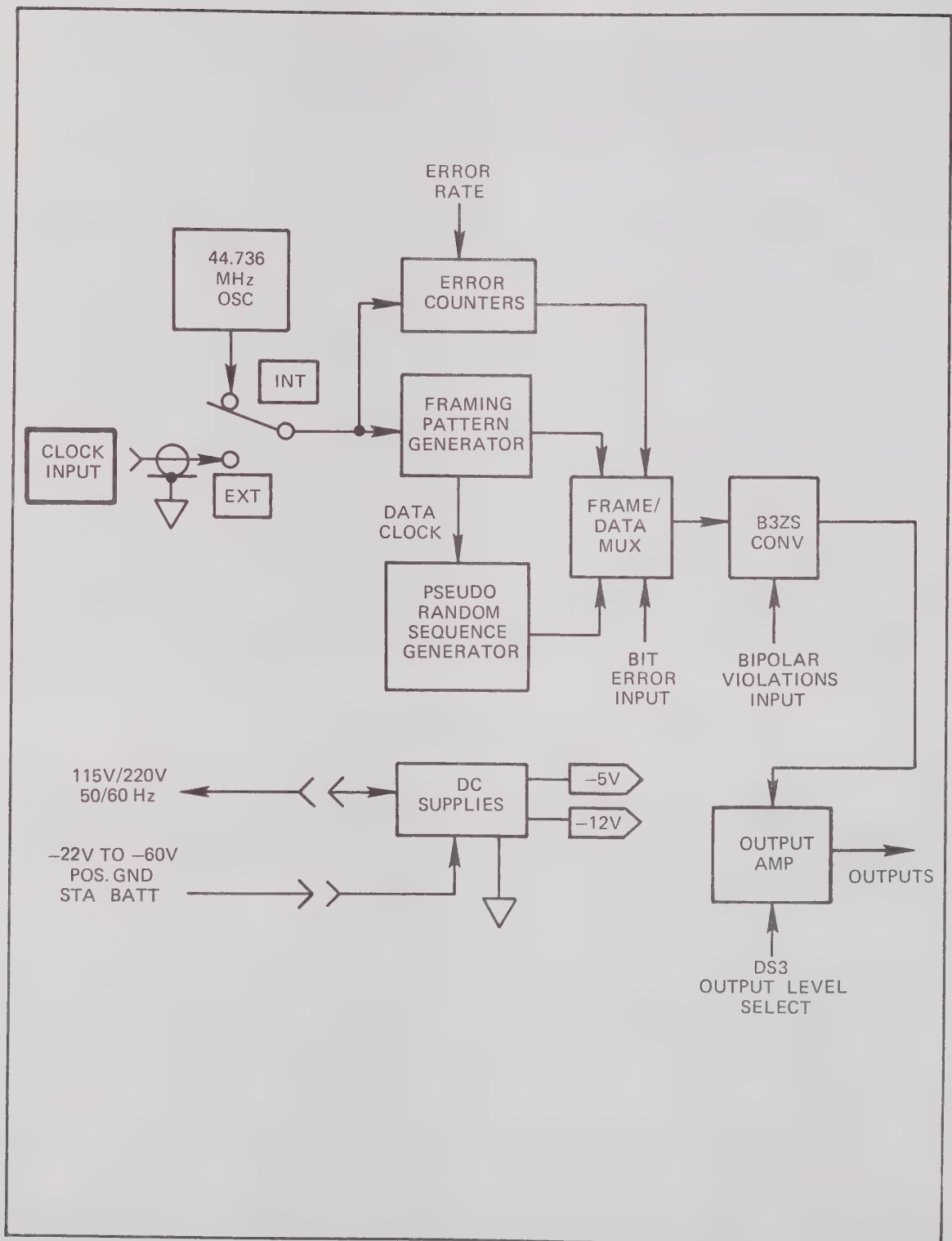


Figure 4.5. Model 4651A Transmitter, Block Diagram

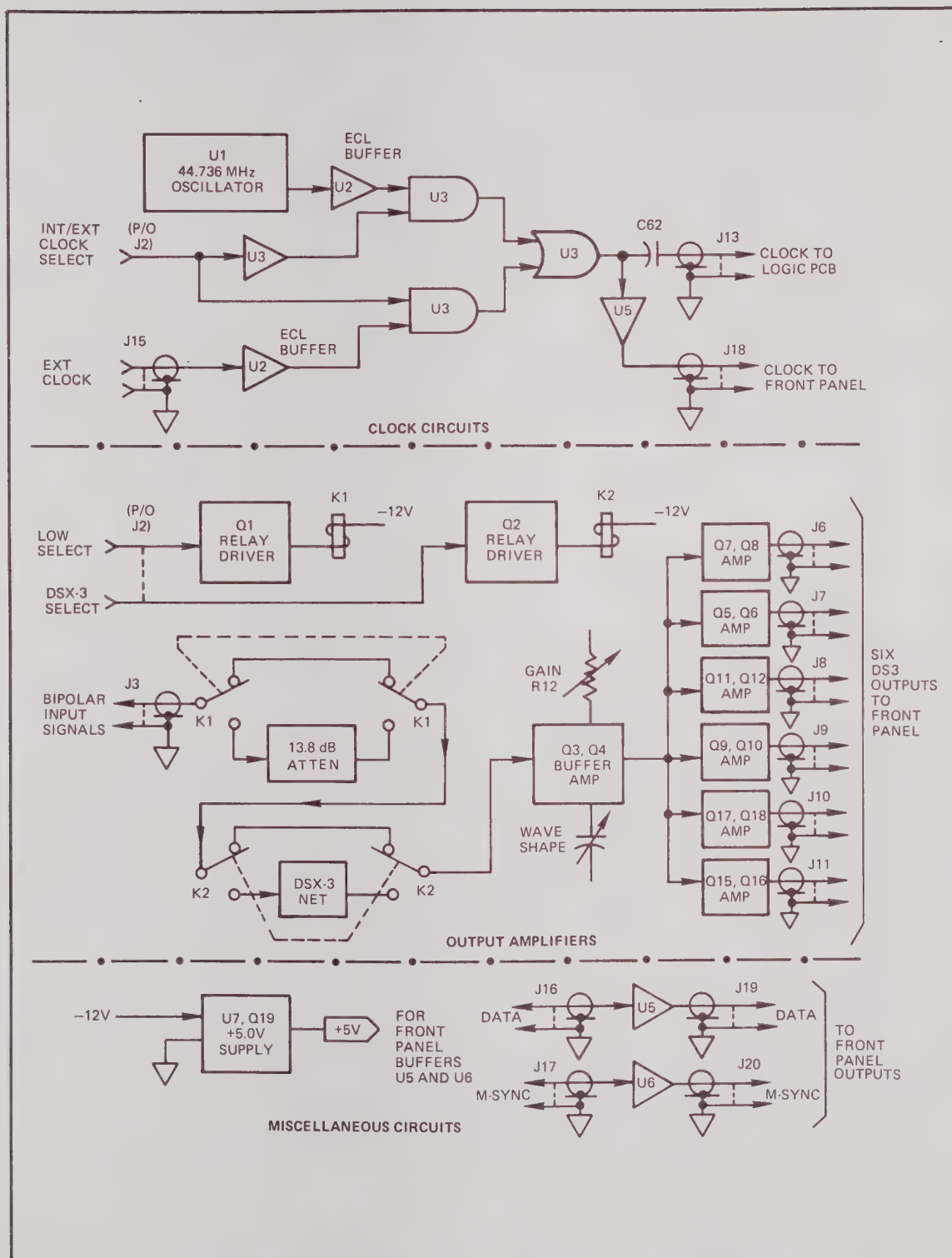


Figure 4.6. Output Amplifier PCB (A3), Block Diagram

below the midrange voltage on U2-10 and the clock signal is converted to an ECL signal at U2-15. The four OR gates of component 13 are used to select the operating clock signal.

The INT/EXT CLOCK SELECT function is applied to U3-10 through noise filter components R85 and C67. The signal is buffered and inverted at U3-14 and U3-15 which drive U3-4 and U3-6, respectively, selecting the system clock. When CL gate outputs are connected, a wired OR is generated as U3-3 and U3-2. If either (or both) gate outputs are a logic 1, the junction will be a logic 1. Thus, clock selection is implemented by forcing the unwanted clock output to a logic 0 by applying a logic 1 into NOR gates U3A and U3B from the front panel switch.

2. Output Amplifiers

The output amplifier inputs a bipolar DS3 signal and provides six individually buffered DS3 outputs. Associated components provide circuitry to implement either 13.8 dB low level attenuator or a DSX-3 cable simulator. Seven feedback-pair amplifiers (plus one more when DSX-3 is selected) provide the desired gain and buffering. The bipolar input signals at connector J3 are routed through two sets of relay contacts. When relay K1 is energized (LOW-OUTPUT LEVEL select), the signals are applied through the 13.8 dB attenuator network of resistors R30, R31, R32, and R33. If relay K2 is energized (DSX-3-OUTPUT LEVEL select), the input signals are applied through a cable simulator network. Signal levels are compensated by transistors Q13 and Q14 and associated components. The DSX-3 network simulates 450 feet of Type 728A cable which is approximated by a network providing 4.8 (± 0.2) dB of loss with the following characteristics:

$$\text{Loss} = 1.09 \sqrt{F} \pm 0.009F \pm 0.2 \text{ dB}$$

$$\text{Phase} = 7.7 \sqrt{F} \pm 248.0F \pm 10.0 \text{ degrees}$$

for $F = 1 \text{ MHz to } 45 \text{ MHz}$ and where F is in MHz.

After passing through the attenuator or network simulator, the signal is then applied to the input of feedback-pair amplifier Q3 and Q4. This signal can be monitored at test port J5 if the moveable jumper used on J4 is set to the proper position. The gain of a feedback-pair amplifier is essentially equivalent to an operational amplifier where the gain is equal to the feedback resistor divided by the input resistor. Gain available for the Q3-Q4 amplifier, from the input at resistor R6 to the output at Q4 emitter, is $R_{11} \text{ plus } R_{12} \text{ divided by } R_6$.

Variable resistor R12 provides the overall gain adjust for the DS3 output signals. The output from transistor Q4 drives six identical feedback-pair amplifiers which provide signals at the front panel DS3 OUTPUT connectors. These six feedback-pair amplifiers each have a gain of 619/301 or 2.06 (plus the tolerance of the components).

3. Miscellaneous Circuits

Pulse Width Modulator (PWM) component U7, transistor Q19, and associated components generate a +5.0V dc at the "+" end of capacitor C78 from a -12.0V dc input. The +5.0V dc supply is required to operate the front panel auxiliary OUTPUT functions. The PWM, U7, is an SG3524 whose description was provided in Section 4.2 under -5.2V/-12.0V DC Power Supply. The circuit (see Figure 7.7) uses U7 and Q19 to generate a flyback voltage on inductor L21 which is rectified and filtered by diode CR5 and capacitor C78. The voltage, as measured at the "+" end of C78, is a low current +5.0V dc.

The zener diode CR6 in this circuit provides overvoltage protection. Since the load on this +5.0V dc source is small and of constant current demand, there is no feedback into PWM U7 for voltage regulation. The PWM, U7, is set to oscillate at approximately 42 kHz. Variable resistor R99 adjusts the pulse width output which also sets the +5.0 volt dc level.

The +5.0V dc supply provides operating voltage for buffer amplifiers U5 and U6. These components are low impedance TTL drivers for front panel OUTPUT connectors labeled CLOCK, DATA, and M-SYNC. All three output signals are guaranteed to provide a 0-to-2.0 volt signal into a 50-ohm load.

B. TRANSMITTER LOGIC PCB ASSEMBLY (A1)

General. A block diagram of the Transmitter Logic circuits is shown in Figure 4.7. The block diagram includes component identification with the circuit function title to assist in understanding the schematic diagram shown in Figure 7.3. In actual operation, the circuits shown as blocks in Figure 4.7 operate almost independently of each other except for the common clock functions and some interconnections. The following descriptions also treat the block circuits independently and identify special interfacing when used. The descriptions presume the reader is familiar with the framing structure of the DS3 signal format structure of the DS3 signal format. In most of the circuit descriptions, the operation will be described with little or no explanation of why the function is needed.

1. Framing Bit Counters

The framing bit counters, using components U2, U3, U10, U20, U30, and U28, perform all the control bit counting and provide timing information to the multiplexer. With correct timing, the multiplexer can select a framing bit, a data bit, a parity bit, etc., as needed. Components U2 and U3 divide the operating clock frequency by 85. As a result, U3 pin 4 outputs a low going pulse approximately one clock period wide every 85 clock cycles. This pulse is nominally 22ns wide for the 44.736 MHz clock frequency. The Dual-D flip-flop U14 resynchronizes the divide-by-85 pulse with the system clock. The signal at U14, pin 15, drives the remaining framing counters while the signal at U14, pin 2, is gated at U15, pins 4 and 5, with the system clock to produce a "gapped clock" signal at U15, pin 2. The "gapped clock" signal is the operating clock with a gap every 85 bits where a framing bit occurs. The "gapped clock" is also designated "DATA" clock since it only clocks on the data bits.

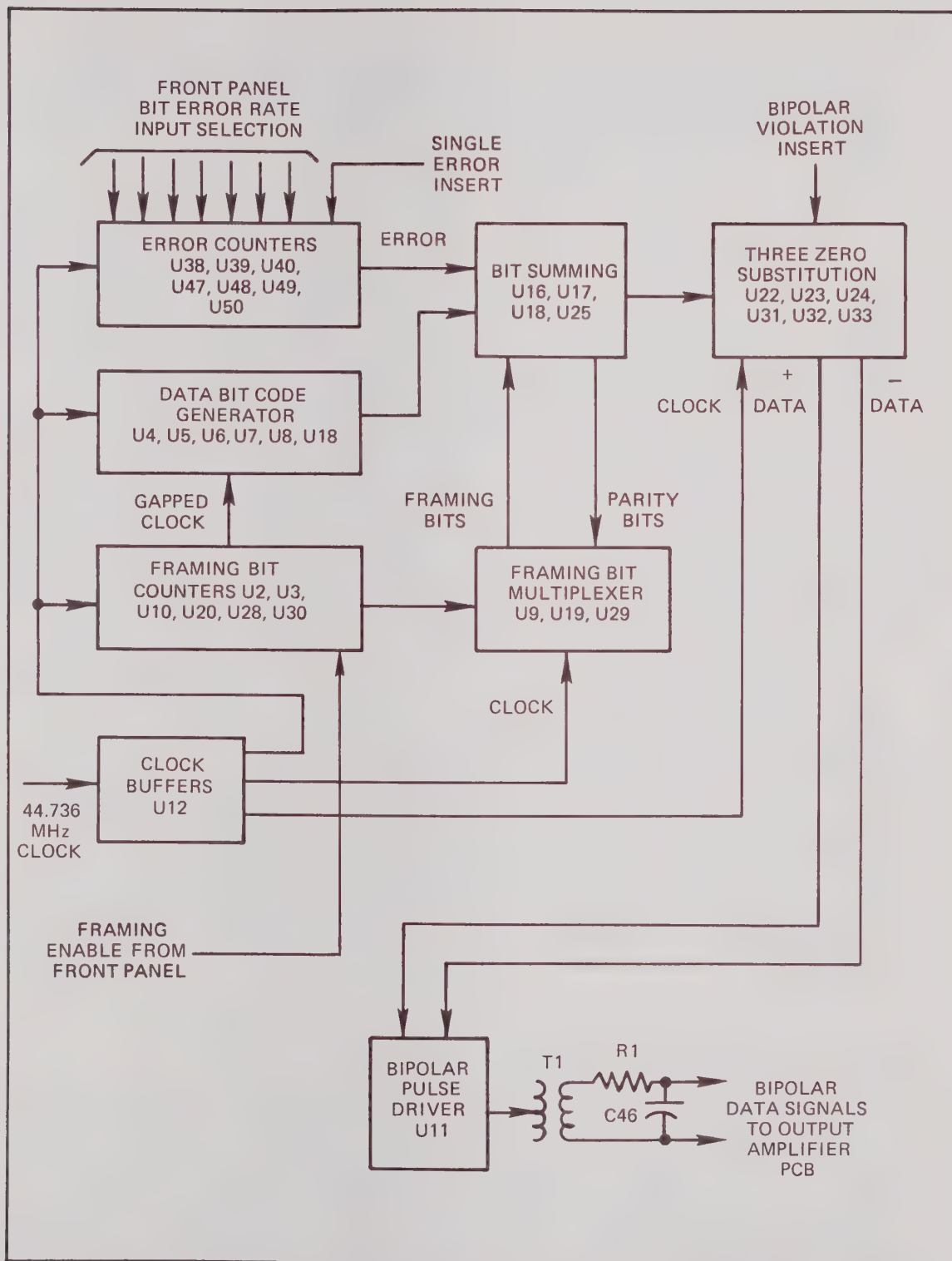


Figure 4.7. Transmitter Logic PCB (A1), Block Diagram (A1),

When framing is disabled, flip-flop U14A is forced to the set state. The "85-bit" counter thus never reaches terminal count, the clock is never "gapped" and no framing bits appear in the output data stream.

The counter U10 divides the framing bit clock by eight to provide sub-framing timing. This output controls a multiplexer, U9, which selects the proper framing bit. See Figure 4.1 and note that there are 8-framing bits, 4 F-bits, 3 C-bits, and 1 M-bit per subframe. Counter U10 divides by eight by presetting to seven and counting down to zero (terminal count), which enables a preset back to seven. The subframe clock at U10, pin 4, is an "enable" for: (1) divider U20 which controls the M-bit multiplexer U19, and for (2) counters U30 and U28 which control the C-bit multiplexer U29. Component U20, which similarly divides by seven in a count-down from six to zero, can be considered as the superframe counter since its terminal count output (U20, pin 4) goes low during the M1 bit (which is the first bit of each super-frame).

Recalling from Figure 4.1 that C-bits are the same within a subframe and have a pattern which repeats every 18 subframes, counters U30 and U28 divide the subframe clock to provide timing signals for multiplexer U29 to generate the C-bit pattern. Counter U30 divides by three and counter U28 divides by six providing an overall division of 18. Note that the 2-divide-by-3 counter outputs control two multiplexer inputs which select the 3-bit pattern "001". The terminal count output of U28 is the other selector input so that every sixth interval the multiplexer shifts the 3-bit code to output "011" and produces the C-bit pattern shown in Figure 4-1.

2. Framing Bit Multiplexer

Components U9, U19, and U29 perform all framing bit multiplexing, and output signals at U9, pin 15, are the framing bits. Component U9 is controlled by the divide-by-8 subframe counter. The three control lines select 1-of-8 inputs, shown in Figure 7.3 as I_0 to I_7 , for output at U9, pin 15. The following chart details the coding, the output bit selection, and the sequencing.

BIT	S ₀	S ₁	S ₂	OUTPUT	Comments
1	0	0	0	I ₀	M ₁ - M-bit follows XXPP010 sequence
2	1	1	1	I ₇	F ₀ - Always a "1"
3	0	1	1	I ₆	C ₁ - C-bit
4	1	0	1	I ₅	F ₀ - Always a "0"
5	0	0	1	I ₄	C ₁ - C-bit
6	1	1	0	I ₃	F ₀ - Always a "0"
7	0	1	0	I ₂	C ₁ - C-bit
8	1	0	0	I ₁	F ₁ - Always a "1"

The counter sequence resets from 0 to 7, counts down to 0, and repeats the cycle. Output signal I⁰ (the M-bit input) connects to the M-frame multiplexer U9, pin 15. The C-bit inputs (I⁶, I⁴, and I²) connect to the C-bit multiplexer U29, pin 15. Finally, as the inputs I¹, I³, I⁵, and I⁷ are sequenced, an output of F-bits are generated in the fixed pattern of 1001, respectively.

Component U19 generates the M-bit pattern which requires a superframe (or 4760 bits) to repeat. Figure 4.1 shows the M-frame pattern is XXPP010, which corresponds to U19 inputs I⁷, I⁶, I⁵, I⁴, I³, I², and I¹, respectively. The X-bit inputs (I⁷ and I⁶) are not connected and therefore are always logic 0. The P-bit inputs (I⁵ and I⁴) represent parity bits and are input from the Parity counter. Remaining inputs (I³, I², and I¹) always generate a "010" pattern.

The M-bits selected by the controlling counter U19 advance with each sub-frame. The C-bit multiplexer U29 generates the following patterns: "001001001001001011". Observe that the pattern consists of five "001" sequences and one "011" sequence. This sequence pattern controls counters U39 and U28 inputs to U29 for selection of U29 inputs I⁶, I⁵, I⁴ for five times and outputs I², I¹, and I⁰ one time. The cycle is repeated outputting the C-bits at U29, pin 15. In this manner, component U9 generates the F-bit sequence 1001 and also uses the M-bit and C-bit inputs to produce the framing bit sequence at U9, pin 15.

Components U4, U5, U6, and U7 are 4-bit shift registers which require timing signals from the gapped clock. The Data Bit Code Generator circuits produce the Pseudo Random sequence code, All One's Data, All Zeros Data, and the BLUE signal, the alternate 0-1 data format. These four shift registers are cascaded to provide one 15-bit shift register. Outputs from the 14th and 15th stages (U7, pins 15 and 2, respectively) are Exclusive ORed by component U18 and the output signal is fed back to the input (U4, pin 13). This sequence produces a pseudo random coded output that is 32,767 bits long.

Control inputs from the front panel OUTPUT switches select the pseudo random bit sequence (PRBS) or force the shift registers into the alternate 0-1 data mode. If the signal applied to connector J1, pin 5, is a logic "1" and J1, pin 3 is a logic "0", the shift registers are enabled to shift and the pseudo random code is generated. If both J1-5 and J1-3 are at logic "0", the ALL ONES DATA output is selected. The shift registers will be in the parallel entry mode and all zeros are continuously loaded into the shift registers. The input data is inverted before being output and the "zero" becomes a "one" in the data stream. If J1-3 is a logic "1" and J1-5 is a logic "0", the shift registers are still in the parallel entry mode, but now a logic "1" is loaded into the 15th stage which produces a logic "0" in the final outputs. If both ALL ONES DATA and PSEUDO RANDOM DATA are selected, both J1-3 and J1-5 are a logic "0" and the shift register is in the parallel loading mode. If the 16th stage is loaded with the inverse of its output (i.e., U7, pin 3 to U21, pins 4 and 5; and U21, pin 2 to U7, pin 6), the circuit will generate a ...1010... or the BLUE signal. This pattern is generated in ALL ZEROS or ALL ONES DATA mode also but logic gates select this output when PSEUDO RANDOM DATA is selected.

4. Error Counters (and Error Insertion) Circuits

Components U38, U39, U40, U47, U48, U49, and U50 form a BCD counter chain which can be set to divide by 10^3 , 10^4 , 10^5 , 10^6 , 10^7 , or set to not divide at all. When no division is selected (or BIT ERROR RATE-CLEAR), the S1 (pin 9) connection of all counters is internally pulled to a logic "0". The counters then operate in the preset mode and perform no division. When selected to divide by 10^2 , connector J1, pin 7 (shown in Figure 7.3) is switched to a

logic "1". To divide by 10^3 , J1, pins 7 and 9 are switched to a logic "1"; and similarly, to divide by 10^7 , J1, pins 7, 9, 11, 13, 15, and 17 are all switched to a logic "1".

Clock signals to the counter chain is the operating clock frequency divided by 10 through component U26. The final output frequency of the counter chain at U38, pin 3 is either a 10^3 , 10^4 , 10^5 , 10^6 , 10^7 , or a 10^8 division of the operating clock frequency. The counter chain output signal is then applied to a dual D flip-flop (U27) which is timed by the operating clock and produces a pulse at U27, pin 3, one clock period wide for each output of the counter chain. This output pulse is applied to an Exclusive OR gate (U18, pin 7) which inverts one bit in the data stream and causes a bit error and consequently a parity error.

Single errors (Bit and/or Parity) can only be inserted when the programmable divider is set for no division and is introducing no errors (i.e., front panel select BIT ERROR RATE-CLEAR). During this mode, component U38 is in a continuous preset condition. When the front panel SINGLE ERROR-DATA BIT or BIPOLAR VIOLATION switch is pressed and released, component U37, pin 14 switches low and high. This will cause U38, pin 3 to also switch and introduce an appropriate error in the data stream.

5. Bit Summing Circuits

The bit summing logic circuits input both data bits and framing bits and combine them into a composition DS3 signal. These logic circuits also perform the parity calculation measurement. Component U17, pin 7, accepts the data bits and U17, pin 6 switches U17, pin 3 output for the duration of the framing bit. Similarly, U17, pin 5, accepts the framing bits and is the inverse of U17, pin 6. This permits U17, pin 2 to be disabled except when framing bits occur. A logic OR condition results when the ECL outputs are correct and the signal at U17, pins 2 and 3, is the DS3 combined signal.

Component U14 generates the control signals to switch the framing bit and data bit gates by inputting the divide-by-85 framing bit clock (U8, pin 4 to U14, pin 7) and the system clock. Components U16 and U18 perform parity calculations by toggling the U16 "Q" output (pin 2) whenever input data is a logic "1". Data and framing bits are logic OR'ed at U17, pins 10 and 11, to force a logic "1" into the parity calculation. Since there are an even number of logic "1's" in the framing bits, a "0" output reflects parity of the data bits. The parity flip-flop output is strobed into U16, pin 10, by the framing bit clock. The latched parity at U16, pin 14, is fed into the Framing Bit Multiplexer U19 to be included in the framing bits.

6. Binary Three Zero Substitution (B3ZS) Circuits

Bipolar data is generated from the unipolar data sequence by transmitting logic "0's" at a 0-volt level and logic "1's" as alternately positive and negative pulses with respect to the 0-volt level. With B3ZS coding, each block of three consecutive 0's is replaced by either a "10'V'" or a "00'V'" where 'V' represents a single pulse with the same polarity as the last one. The choice to use "10'V'" or "00'V'" is made so that the number of bipolar pulses between zero substitutions is odd. A four-bit shift register, U24, is loaded with the unipolar data stream. The data output is from the last stage "Q3" pin. If three 0's occur in the data stream, the output functions of U24 (labeled Q0, Q1, and Q2) will all be low. Since they are connected in a "wired OR" arrangement, the junction will only go low if three 0's occur.

When three 0's occur, U24 is switched to the parallel entry mode and either "101" or "001" is loaded into U24. The "101" or "001" is selected to give an odd number of "1's" between violations with U32 counting the "1's" between violations and feeding into U24. When U24 is in the parallel loading mode, U23 is also enabled into the parallel mode with "0100" being loaded. As this sequence shifts out of U23, the "1" is synchronized to the violation bit location of the data in U24 and the "1" in U23 inverts to the "1" bit polarity causing a violation.

Component U32A controls whether the pulse is positive or negative and causes successive "1" pulses of the same polarity. The single error bipolar violation insert function is provided by causing U32B not to alternate states for one data "1" bit. This assures the next B3ZS substitution will have an even number of "1's" and cause a bipolar violation.

Transformer T1 is driven in a differential push-pull arrangement by U11. The outputs of U32A control the push-pull selection and the signal at U21-9 are data "1's" gated with the clock signal so that the output drive signals have a 50 percent duty cycle when a "1" is output. The "l11" bit, which is the first bit of a superframe, is shifted through U22 and U31 to drive the front panel OUTPUT-M-SYNC connector.

CHAPTER 5 MAINTENANCE

5.1 GENERAL

Due to the reliability and nature of the equipment, periodic maintenance and alignment of the Model 4651A BERTS Transmitter is not necessary or recommended, beyond keeping the air intake filters clean. It is recommended, however, that all units be inspected and calibrated by Scientific-Atlanta personnel or representatives on a yearly basis. This action will insure that the equipment will meet all published specifications and provide the user with trouble free, accurate performance. The nearest Scientific-Atlanta representative or the nearest Regional Service Center can arrange for such factory calibration. Regional Service Centers are listed on the last page of this chapter.

5.2 TROUBLESHOOTING

The intent of this section is to enable the technician to repair equipment out of warranty by locating and identifying defective printed circuit boards. Once the defective printed circuit board has been isolated, either a pre-tested replacement may be obtained from Scientific-Atlanta or further troubleshooting may be performed. It is suggested that prior to troubleshooting within a printed circuit board, the technician review thoroughly the applicable section in the Theory of Operation, Chapter 4, and the appropriate schematic.

Signals generated by the Model 4651A BERTS Transmitter are identified on the schematic and can be traced through circuits using appropriate test equipment. While it is not possible to describe all the failure modes associated with a Model 4651A operating into a system, there are basic steps which can be

performed to locate and isolate malfunctions. This chapter is arranged to provide a logical sequence of basic procedures to isolate a fault within a Model 4651A.

The recommended tests should be performed and verified using a Hewlett-Packard Model 3465A Digital Volt Meter (DVM) for voltage and resistance measurements and a Tektronix Model 475 Oscilloscope to observe waveform patterns. The test equipment should be calibrated and operating within its specified accuracy. Equivalent or better test equipment may be substituted when required.

5.3 TROUBLESHOOTING THE MODEL 4651A TRANSMITTER

General. Figure 5.1 is a flow chart of step-test sequences to isolating a malfunction within a Model 4651A BERTS Transmitter. Obviously the malfunction symptoms will dictate which steps should be performed and which steps can be set aside as secondary or to be performed if the initial steps fail to isolate the malfunction. If a malfunction is isolated to a printed circuit board which can be field calibrated (i.e., a power source PCB), perform the entire calibration procedure before attempting to verify normal operation. If a malfunction is isolated to a source that does not respond to normal repair procedures and/or calibration, then the suspect source should be replaced by an identical item purchased from Scientific-Atlanta.

A. MODEL 4651A VISUAL INSPECTION

A visual inspection check of a Model 4651A should consist of the following steps as a minimum:

- Check all PCB's for proper installation and location.
- Check for broken wires. This includes all PCB connections, coax and flat cables, and panel connections. Examine PCB components for obvious defects (i.e., discoloration, bulging, overheating, etc.).

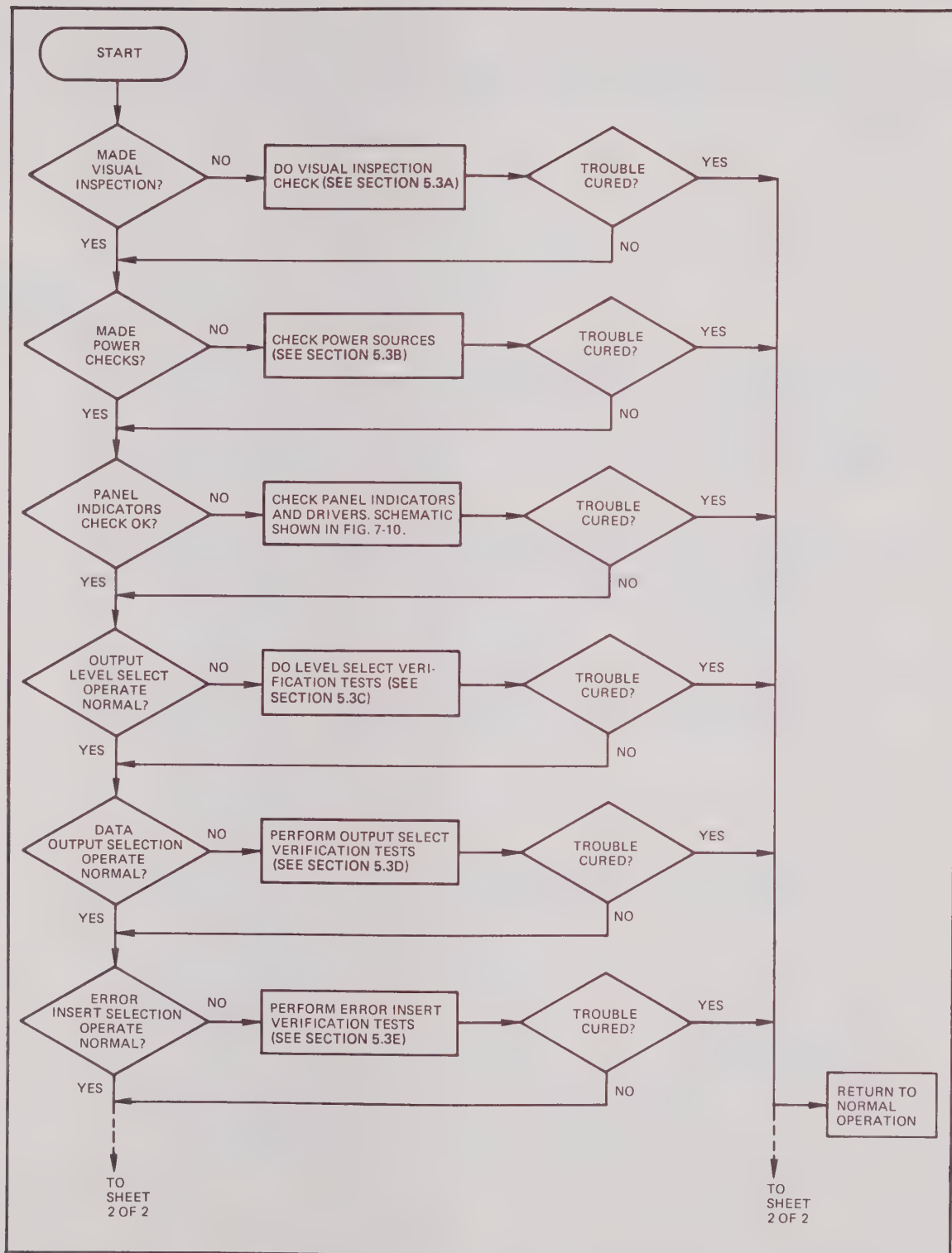


Figure 5.1. Troubleshooting Flow Chart (Sheet 1 of 2)

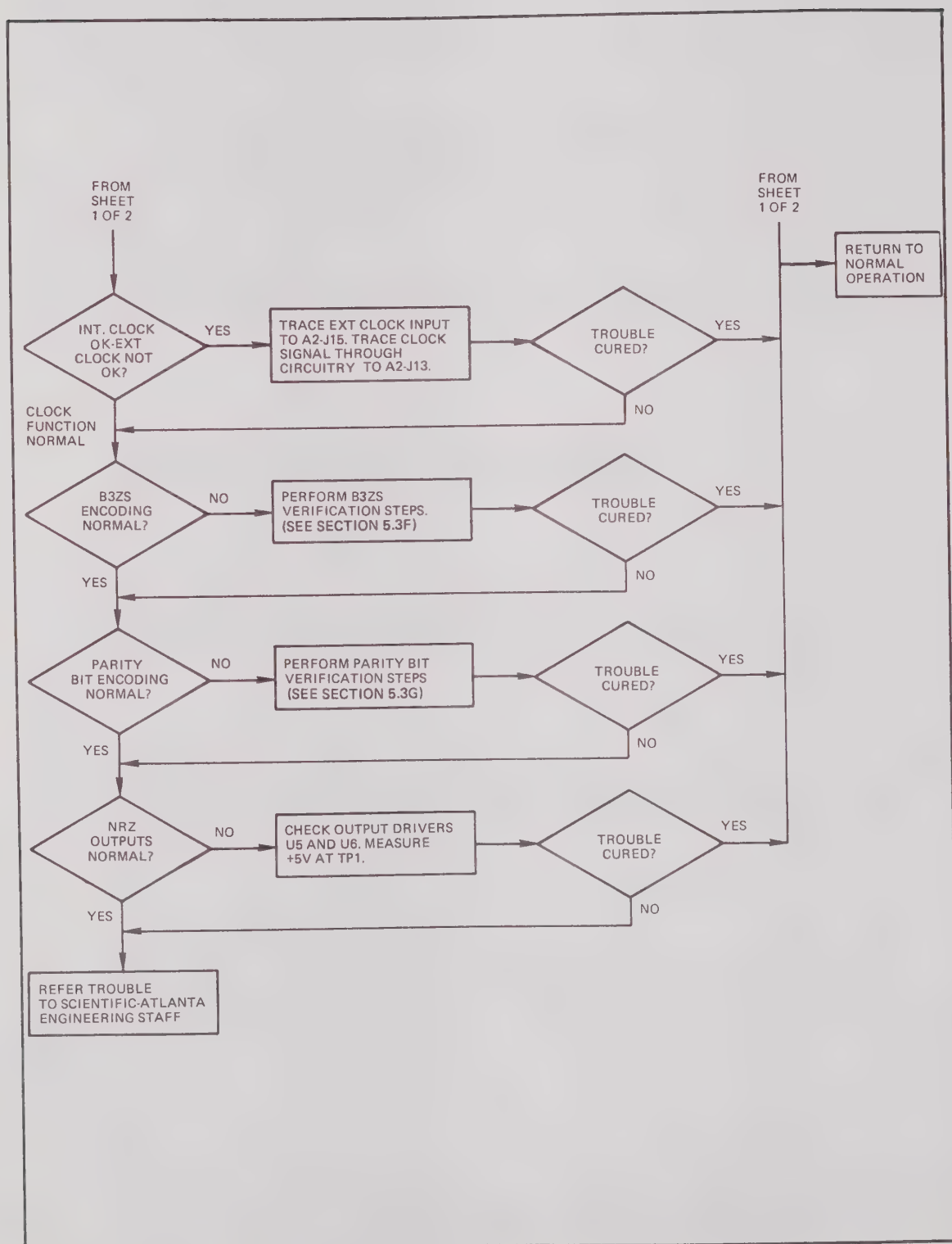


Figure 5.1. Troubleshooting Flow Chart (Sheet 2 of 2)

- Check all cables for proper installation. Inspect for bent pins, discolored or deformed connector shells, frayed or punctured insulation, etc.

B. MODEL 4651A POWER SOURCES

A check of the Model 4651A BERTS Transmitter power sources should be verified using the DVM and the following tests:

- Check the AC source (if used). Determine if the ac source is controlled by a switch. Check the source ac at the chassis connector. Verify that the voltage select PCB next to the ac fuse is properly installed. (See Figure 5.2.) Check the ac fuse for continuity. Check ac distribution using schematic diagrams in Chapter 7.
- Check the DC Input source (if used). Determine if the dc source is connected using the correct polarity. Check the dc fuses on the Rectifier and Filter Assembly PCB (A5A1) for continuity. Check the input dc source distribution using schematic diagrams in Chapter 7.
- Check the operation of the -5.2V/-12V Power Supply PCB (A2). Verify the following requirements. If the requirements are not met, troubleshoot and repair the power supply PCB.

On PCB A2, measure from J1-3 to J1-1.

Requirement: $-5.2(\pm 0.3)\text{V dc}$

On PCB A1, measure from J1-2 to J1-1.

Requirement: $-5.2(\pm 0.3)\text{V dc}$

On PCB A2, measure from J1-3 to J1-9.

Requirement: $-12(\pm 0.4)\text{V dc}$

On PCB A3, measure from J1-1 to J1-2.

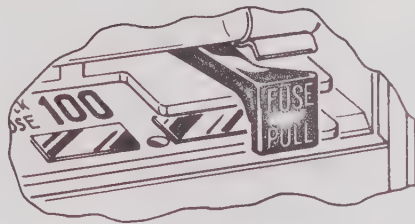
Requirement: $-12(\pm 0.4)\text{V dc}$

On PCB A3, measure from J1-1 to J1-3.

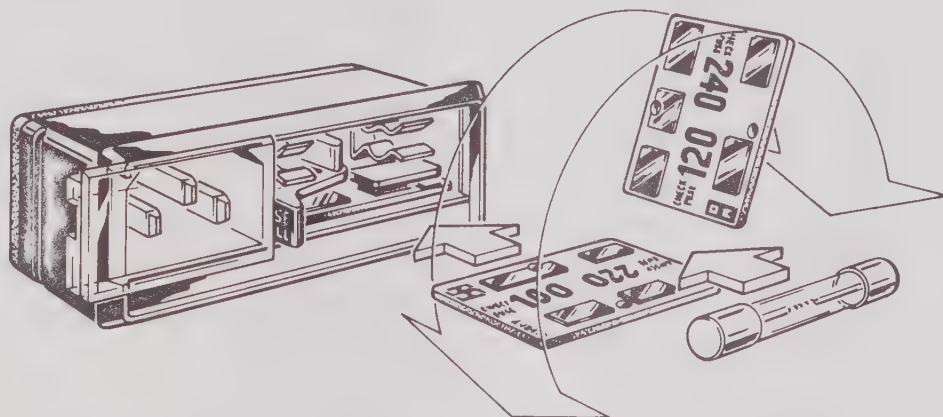
Requirement: $-5.2(\pm 0.3)\text{V dc}$

On PCB A3, measure from chassis ground to A3-TP1.

Requirement: $+5.0(\pm 0.25)\text{V dc}$



Operating voltage is shown through the sliding plastic window.



HOW TO SELECT OPERATING VOLTAGE

1. Remove the ac power cord connector.
2. Slide the plastic window to the left.
3. Carefully operate FUSE PULL tab to the left.
4. Carefully remove both the fuse and printed circuit board. A small hole is provided to accommodate a wire pull if necessary.
5. Correctly orient the printed circuit board so the desired voltage is located on the top left side.
6. Carefully return to printed circuit board to the original location. Be sure it is securely seated.
7. Return FUSE PULL tab to the normal position.
8. Replace the original fuse with one selected for correct fuse value.

Illustrations courtesy of Corcom Corp., Chicago, Ill.

Figure 5.2. Selecting the Proper Operating Voltage

C. OUTPUT LEVEL SELECT

A check of the front panel OUTPUT LEVEL select functions should be verified using the oscilloscope and the following tests:

- Verify that a B3ZS output signal exists from the Transmitter Logic PCB (A1) at connector J3.
- On the Output Amplifier PCB (A3) move the jumper to connect J4-2 to J4-4. Verify a B3ZS signal at the Test Port. If the requirement is met, return the jumper to the original position. If the requirement is not met, trace the B3ZS signal from connector A3J3 through the attenuators and the DSX-3 network to connector A3J5. Repair any malfunction.
- Verify operation of relays A3K1 and A3K2.
- Trace the B3ZS signal from the A3J5-Test Port to the faulty connector.

(NOTE: Amplifier transistors A3Q3 and A3Q4 are common to all outputs. Be sure to check chip-type bypass capacitors.)

D. DATA OUTPUT SELECT

A check of the front panel data OUTPUT select functions should be verified using the oscilloscope and the following tests:

- Verify switch operation;
 1. Selecting PRBS puts an ECL Logic "1" on connector pin A1J1-5.
 2. Selecting "1111" puts an ECL Logic "0" on connector pin A1J1-18.
 3. Selecting "0000" puts an ECL Logic "1" on connector pins A1J1-3 and A1J1-18.
 4. Selecting "BLUE" puts an ECL Logic "1" on connector pins A1J1-3 and A1J1-18.
 5. Deselecting "FRAMING" puts an ECL Logic "1" on connector pin A1J1-1.
- Verify data signals present at A3U7-2 and A3U7-3.
- Verify data signal path from A3U7 through A3U21, A3U18, A3U17 to A3U25-10.
- Verify data signal path through B3ZS Encoder, A3U23, A3U24, A3U33, A3U32 to transformer A3T1 and to connector A3J3.

E. ERROR INSERT SELECTION

A check of the front panel SINGLE ERROR select function should be verified using the DVM for continuity checks and the oscilloscope for signal tracing when performing the following tests:

- SINGLE ERROR-DATA BIT. Check the switch operation while observing the inputs to A3U37-12 and A3U37-13. Also observe the output at A3U37-14.
- SINGLE ERROR-BIPOLAR VIOLATION. Check the switch operation while observing the inputs to A3U44-4 and A3U44-5. Also observe the output at A3U44-3.
- If necessary, trace error insert pulse from A3U43-15 to A3U33-14.
- BIT ERROR RATE Switches. Check switch input to the divider chain of A3U38, A3U39, A3U40, A3U47, A3U48, A3U49, and A3U50.
- Check the error insert signal path from A3U38-3 to A3U27-4, to A3U27-2, to A3U18-7.

F. B3ZS ENCODING

A check of the B3ZS encoding function can be observed using the oscilloscope with the following tests:

- Select unframed "0000" and verify the DS3 outputs to be two positive pulses followed by two negative pulses. If this is not verified, troubleshoot the B3ZS Encoder at A3U23, A3U24, and A3U33.

G. PARITY BIT ENCODING

A check of the Parity Bit encoding function can be observed using the oscilloscope with the following tests:

- Check the Parity toggle flip-flop (A3U16A) for normal operation. Then check the Latch flip-flop (A3U15B) for normal operation. If these tests are verified and trouble persists, check the Framing Bit Multiplexer A3U19 and A3U9.

If the NRZ OUTPUT signal is verified to be good and trouble conditions continue, an unusual problem may be present. Situations of this nature are best referred to the Scientific-Atlanta Engineering Staff.

5.4 CALIBRATION

General. The following procedures describe adjustments which can be accomplished under normal conditions in a general electronic repair center. Adjustments to the power supplies are provided in the first procedure with four additional calibration adjustments for the Model 4651A BERTS Transmitter.

A. TEST EQUIPMENT

The test equipment or its equivalent listed in Table 5.1 is required to perform the tests in this procedure. All test equipment must be calibrated and operating within its specified accuracy.

Table 5.1
Test Equipment

Description	Model	QTY	Manufacturer
DVM	3465A	1	Hewlett-Packard
Oscilloscope	475	1	Tektronix
Frequency/Period Counter	7014	1	Systron Donner
DC Supply, 0-60V, 9A	DCR 60-9B	1	Sorenson
IF Sweeper	1700	1	General Radio
RF Network Analyzer	1710	1	General Radio
75 Ohm Termination	011055	2	Tektronix
Probe, FET	P6201	2	Tektronix
Probe, 1M Ω	P6106	2	Tektronix

B. -5.2V/-12.0V DC POWER SUPPLY CALIBRATION

The -5.2V/-12.0V Power Supply PCB will be calibrated in the unit operating under loaded conditions. The ac source should be removed and a -20V dc source should be applied to the "DC POWER" connector. The power supply PCB is accessible by removing the bottom cover. With the external dc power source

off, extract the power supply PCB and lay it on top of the chassis with cables attached. Use insulating material such as cardboard for safety. Switch the dc power source on.

Connect the DVM to monitor the -12.0V dc output between J1-3 (common) and J1-9. Adjust variable resistor R7 counterclockwise two turns from the point it last affects the measured -12.0V dc output.

Connect the DVM to monitor the -5.2V dc output between J1-3 (common) and J1-1. Adjust variable resistor R30 counterclockwise two turns from the point it last affects the measured -5.2V dc output.

Adjust variable resistor R23 to set the -5.2V dc output to -5.25 (± 0.1)V dc.

Adjust variable resistor R30 slowly clockwise to the point the DVM indication starts to decrease. Then adjust R30 counterclockwise two turns from this point.

Connect the DVM to monitor the -12.0V outputs between J1-3 and J1-9. The DVM should indicate -12.0(± 0.3)V dc. Adjust variable resistor R7 slowly clockwise until the -12.0V dc outputs start to decrease, then adjust R7 counterclockwise two turns from this point. This completes calibration of the -5.2V/-12.0V Power Supply PCB.

C. TRANSMITTER CALIBRATION

+5V dc Adjust. Connect the DVM to measure dc volts from chassis ground to TP1 on the Output Amplifier PCB (A3). If necessary, adjust variable resistor R99 for a +5.0(± 0.1)V dc indication.

44.736 MHz Oscillator Adjust. Normal frequency tolerance on this oscillator is 20 ppm (or ± 895 Hz) which corresponds to a frequency between 44,735,105 Hz to 44,736,895 Hz. Connect the frequency counter to monitor the front panel CLOCK output. If the frequency is outside the above range, remove

the protective tape over the frequency adjust access hole on the side of the oscillator module, U1, on the Output Amplifier PCB (A3). Adjust for a frequency of 44,736,000 (± 200) Hz. Replace tape over access hole.

DSX-3 Cable Simulator Adjust. The simulator network electronically resembles the characteristics of 450 feet of 728A cable. It is largely made up of fixed components and calibration of the one adjustment is not imperative if a sweeper is not available. If it is desired to adjust capacitor A3C45, or to observe cable simulator response, connect the sweeper as shown in Figure 5.3 and adjust A3C45 for a response shown in Figure 5.4.

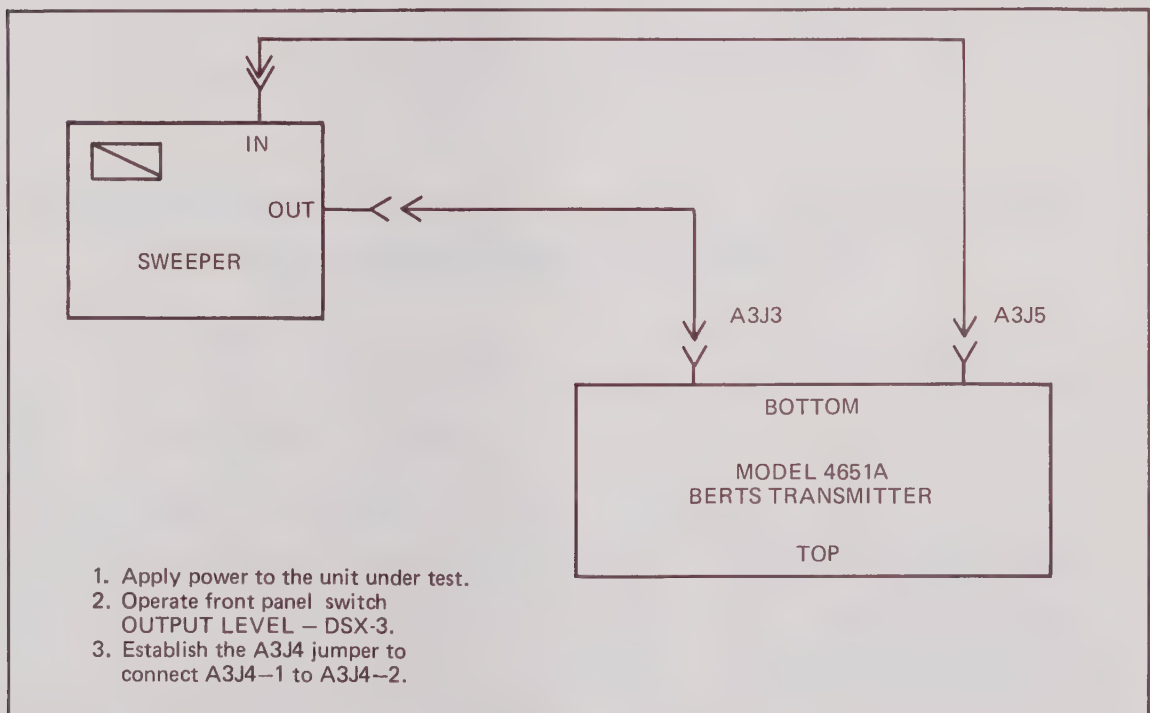


Figure 5.3. DSX-3 Network Adjustment

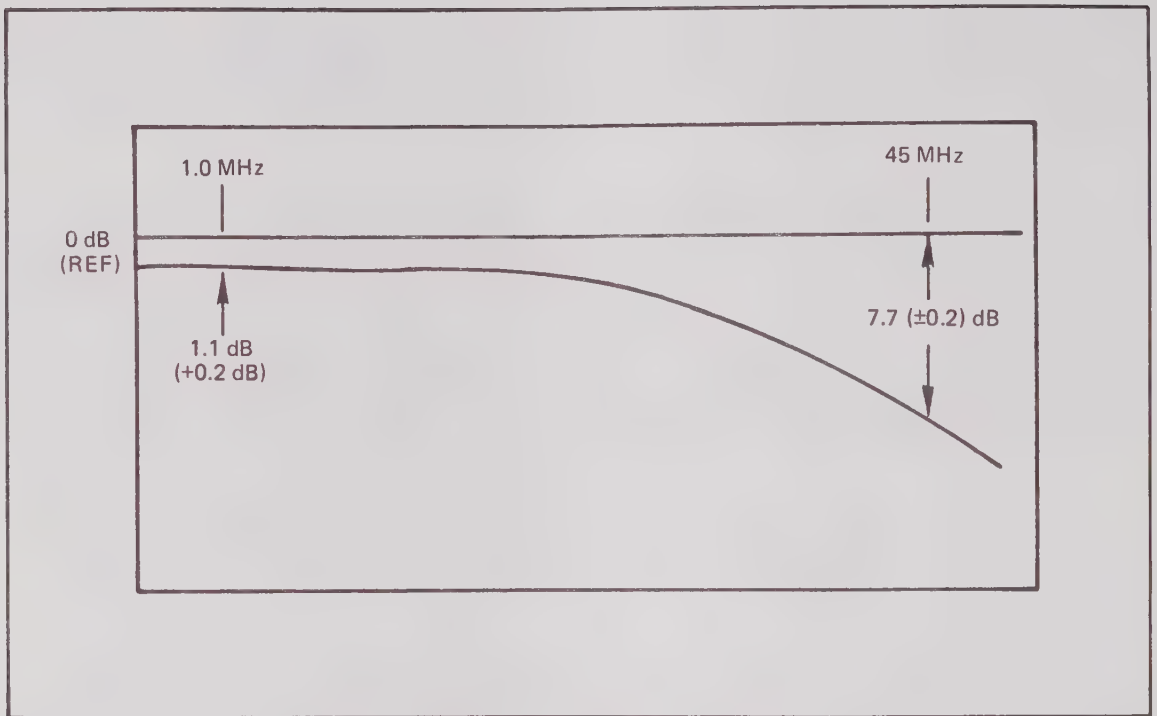


Figure 5.4. Amplifier Response

DS3 Output Amplifier High Level Response Adjust. Select the DS3 high output level. Connect an oscilloscope to monitor one of the six front panel DS3 outputs being certain that the cable input to the scope has a 75-ohm termination. If the output meets waveform characteristics shown in Figure 5.5, do not adjust the amplifier response. If adjustment is required, slowly adjust the GAIN variable resistor A3R12 and frequency response capacitor A3C12 to get the desired response. There is interaction between the GAIN adjust and frequency response adjust, so that the gain cannot always be set to a desired level with frequency response adjusted for proper over- and under-shoot. But rather a gain level may have to be compromised, still within specified output levels, to get the desired response.

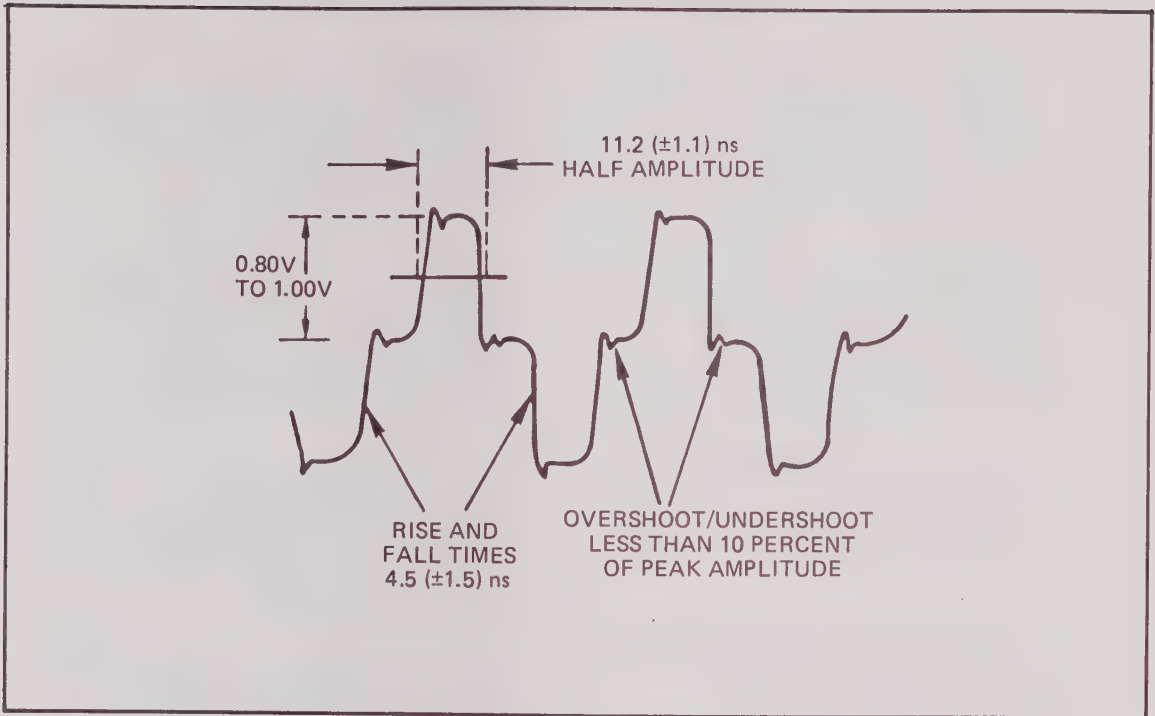


Figure 5.5. DS3 High Level Output Waveform

5.5 REGIONAL SERVICE CENTERS

Regional Service Centers capable of performing periodic maintenance and providing assistance associated with the Model 4651A BERTS Transmitter and other Scientific-Atlanta equipment are listed below. Service Assistance for areas not listed can be provided through the Scientific-Atlanta Field Service Center, 4025 Pleasantdale Road, Atlanta, Georgia 30340; TEL: 404-441-4200; TWX: 810-766-4912; TELEX: 0542898.

DOMESTIC REGIONAL SERVICE CENTERS**Northeastern Regional Office**

149 Middlesex Turnpike
Burlington, Massachusetts 01803
Tel: 617-272-1256

Midwest Regional Office

Fidelity Bldg., Suite 306
11550 N. Meridian
Carmel, Indiana 46032
Tel: 317-846-7142

Washington D.C. Regional Office

Washington Business Park
5100-J Philadelphia Way
Tanham, Maryland 20706
Tel: 301-577-4830

Southwestern Regional Office

1237 Executive Drive, East
Richardson, Texas 75081
Tel: 214-238-1116

Mid Atlantic Regional Office

2100 Route 208
Fair Lawn, New Jersey 07410
Tel: 201-791-8777

So. California Regional Office

P.O. Box 2668
10039 Pioneer Boulevard
Santa Fe Springs, California 90670
Tel: 213-949-9411

Southeastern Regional Office

4025 Pleasantdale Road
Atlanta Georgia 30340
Tel: 404-449-2021

No. California Regional Office

3375 Scott Boulevard, Suite 304
Santa Clara, California 95051
Tel: 408-496-1040

Florida Regional Office

P.O. Box 2143
841 West Emmett St.
Kissimmee, Florida 32741
Tel: 305-846-0055

INTERNATIONAL SERVICE CENTERS

CANADA

Scientific-Atlanta, Ltd.

1640 Bonhill Road

Unit 6

Mississauga, Ontario L5T1C8

Tel: 416-677-6555

Telex: 06983600

GERMANY

Scientific-Atlanta GmbH

Albert Schweitzerstrasse 66/3

D-8000 Munich 83, Germany

Tel: 49.8967.1091

Telex: 5212264

ENGLAND

Scientific-Atlanta, Ltd.

Horton Manor

Stanwell Road

Horton

Slough SL3 9PA, England

Tel: 44.2812-3211

Telex: 849406

ITALY

Scientific-Atlanta, S.p.A.

Via Benedetto Croce 19

00142 Rome, Italy

Tel: 39.6.5420244

Telex: 721441

FRANCE

Scientific-Atlanta S.A.

4 Avenue Gabriel Peri

78360 Montesson

France

Tel: 33.3.9769191

Telex: #46385

CHAPTER 6 PARTS LISTS

6.1 GENERAL

The parts lists for a Model 4651A BERTS Transmitter are included in this chapter. Special modifications, if any, are enclosed in the envelope in the rear of this manual.

6.2 EXPLANATION OF COLUMN HEADINGS

REF. DESIG. PREFIX. This identifies the assigned reference designation applicable to a system or equipment sub-unit having a separate prefix and arrangement of individual components.

REF. DESIG. This identifies the components of the sub-unit in alpha-numerical order.

PART NO. A five or six digit number assigned by Scientific-Atlanta to the specific part for identification and correct replacement ordering information.

DESCRIPTION. A brief electrical and/or mechanical description of the component.

FSCM CODE. The proper Federal Supply Code for Manufacturers is entered in this column. The code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name), and are in effect as of the publication date of this manual.

VENDOR PART NUMBER. The number assigned to a part by an outside supplying manufacturer is listed in this column.

6.3 ORDERING PARTS

When ordering parts from Scientific-Atlanta, always include the Scientific-Atlanta part number, the part description, the unit name, the unit serial number, the subassembly name, the part manufacturer (FSCM), and the manufacturer's part number.

6.4 PARTS SUBSTITUTION

Common components may differ from those identified in the parts list. This difference is due to the substitution of a more current part during assembly. When this occurs, the replacement may be either a part identical to the type removed or a part meeting the description given in the parts list.

PARTS LIST INDEX

<u>Ref Desig.</u>	<u>Part No.</u>	<u>Description</u>	<u>Page</u>
A1	252908	Logic PCB Assembly	6-4
A2	220905	Power Supply PCB Assembly	6-8
A3	220908	Output Amplifier PCB Assembly	6-11
A4	252909	Front Panel Assembly	6-16
A4A1	252905	Front Panel PCB Assembly	6-17
A5	220950	Rear Panel Assembly (Serial No. 10* and Below)	6-18
A5	252842	Rear Panel Assembly (Serial No. 11* and Above)	6-18
A5A1	220902	Rectifier and Filter PCB Assembly (Serial No. 10* and Below)	6-19
A5A1	252781	Rectifier and Filter PCB Assembly (Serial No. 11* and Above)	6-19
A6	254965	Current Limiter Assembly (Serial No. 10* and Below)	6-20
A6	254965	Current Limiter Assembly (Serial No. 11* and Above)	6-20
A6	78600	Not Assigned (Serial Number 57* and Above)	
W7	220964	Cable Assembly, ECL Interface	
W8	220965	Cable Assembly, ECL Interface	
W9	220966	Cable Assembly, ECL Interface	
W10	220967	Cable Assembly, ECL Interface	
	220955	Power Wiring Harness	
	89672	Cord Set, #18 3-Wire 125V, 9 ft.	

*Serial Numbers are Approximate.

TRANSMITTER LOGIC PCB ASSEMBLY - 252908

REF DESIG PREFIX: 4651A-A1

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
C 1	0070544	CAPACITR .001 MF 1KV CER DISC 25F 10%	71590	DD102
C 2	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 3	0081098	CAPACITR .47 MF 50V CER MONO 20%	72982	8131-050-651-474M
C 4	0081098	CAPACITR .47 MF 50V CER MONO 20%	72982	8131-050-651-474M
C 5	0081098	CAPACITR .47 MF 50V CER MONO 20%	72982	8131-050-651-474M
C 6	0081098	CAPACITR .47 MF 50V CER MONO 20%	72982	8131-050-651-474M
C 7	0081098	CAPACITR .47 MF 50V CER MONO 20%	72982	8131-050-651-474M
C 8	0081098	CAPACITR .47 MF 50V CER MONO 20%	72982	8131-050-651-474M
C 9	0081098	CAPACITR .47 MF 50V CER MONO 20%	72982	8131-050-651-474M
C 10	0081098	CAPACITR .47 MF 50V CER MONO 20%	72982	8131-050-651-474M
C 11	0081098	CAPACITR .47 MF 50V CER MONO 20%	72982	8131-050-651-474M
C 12	0081098	CAPACITR .47 MF 50V CER MONO 20%	72982	8131-050-651-474M
C 13	0081098	CAPACITR .47 MF 50V CER MONO 20%	72982	8131-050-651-474M
C 14	0081098	CAPACITR .47 MF 50V CER MONO 20%	72982	8131-050-651-474M
C 15	0081098	CAPACITR .47 MF 50V CER MONO 20%	72982	8131-050-651-474M
C 16	0079003	CAPACITR 100 MF 16V	80183	500D107G016DC7
C 17	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 18	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 19	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 20	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 21	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 22	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 23	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 24	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 25	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 26	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 27	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 28	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 29	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 30	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 31	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 32	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 33	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 34	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 35	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 36	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 37	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 38	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 39	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 40	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 41	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 42	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 43	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 44	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 45	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 46	0082004	CAPACITR 3.3 PF 100V CER DISC COJ +/- .25P	72982	835-024-C0J0-339C
C 47	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 48	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 49	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 50	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 51	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 52	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 53	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 54	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 55	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 56	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 57	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 58	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 59	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 60	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 61	0081098	CAPACITR .47 MF 50V CER MONO 20%	72982	8131-050-651-474M
C 62	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K

TRANSMITTER LOGIC PCB ASSEMBLY - 252908

REF DESIG PREFIX: 4651A-A1

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
J 1	0087451	CONN HEADER DBL ROW STRAIGHT 26-PIN PC		87478-4
J 2	0087355	CONN RECT PIN HEADER PC BD 2 CIRCUIT RED		2-350539-2
J 3	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 4	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 5	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 6	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
R 1	0078938	RESISTOR 68 OHM 1/4W 5% COMP	01121	RCR07G680JS
R 2	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 3	0071920	RESISTOR 390 OHM 1/4W 10% COMP	01121	RCR07G391KS
R 4	0074710	RESISTOR 2.2K OHM 1/4W 5% COMP	01121	RCR07G222JS
R 5	0081852	RESISTOR 430 OHM 1/4W 5% COMP	01121	RCR07G431JS
R 6	0071920	RESISTOR 390 OHM 1/4W 10% COMP	01121	RCR07G391KS
R 7	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 8	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 9	0071897	RESISTOR 150 OHM 1/4W 10% COMP	01121	RCR07G151KS
R 10	0071913	RESISTOR 270 OHM 1/4W 10% COMP	01121	RCR07G271KS
R 11	0071887	RESISTOR 100 OHM 1/4W 10% COMP	01121	RCR07G101KS
R 12	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 13	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 14	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 15	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 16	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 17	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 18	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 19	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 20	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 21	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 22	0077524	RESISTOR 75 OHM 1/4W 5% COMP	01121	RCR07G750JS
R 23	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 24	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 25	0071938	RESISTOR 680 OHM 1/4W 10% COMP	01121	RCR07G681KS
R 26	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 27	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 28	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 29	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 30	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 31	0071966	RESISTOR 1.5K OHM 1/4W 10% COMP	01121	RCR07G152KS
R 32	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 33	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 34	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 35	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 36	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 37	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 38	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 39	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 40	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 41	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 42	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 43	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 44	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 45	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 46	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 47	0071897	RESISTOR 150 OHM 1/4W 10% COMP	01121	RCR07G151KS
R 48	0071907	RESISTOR 220 OHM 1/4W 10% COMP	01121	RCR07G221KS
R 49	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 50	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 51	0071887	RESISTOR 100 OHM 1/4W 10% COMP	01121	RCR07G101KS
R 52	0071894	RESISTOR 120 OHM 1/4W 10% COMP	01121	RCR07G121KS
R 53	0071913	RESISTOR 270 OHM 1/4W 10% COMP	01121	RCR07G271KS
R 54	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 55	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 56	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 57	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS

TRANSMITTER LOGIC PCB ASSEMBLY - 252908

REF DESIG PREFIX: 4651A-A1

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
R 58	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 59	0071879	RESISTOR 82 OHM 1/4W 10% COMP	01121	RCR07G820KS
R 60	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 61	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 62	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 63	0071913	RESISTOR 270 OHM 1/4W 10% COMP	01121	RCR07G271KS
R 64	0071897	RESISTOR 150 OHM 1/4W 10% COMP	01121	RCR07G151KS
R 65	0071907	RESISTOR 220 OHM 1/4W 10% COMP	01121	RCR07G221KS
R 66	0071897	RESISTOR 150 OHM 1/4W 10% COMP	01121	RCR07G151KS
R 67	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 68	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 69	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 70	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 71	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 72	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 73	0071897	RESISTOR 150 OHM 1/4W 10% COMP	01121	RCR07G151KS
R 74	0071913	RESISTOR 270 OHM 1/4W 10% COMP	01121	RCR07G271KS
R 75	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 76	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 77	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 78	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 79	0071920	RESISTOR 390 OHM 1/4W 10% COMP	01121	RCR07G391KS
R 80	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 81	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 82	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 83	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 84	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 85	0071887	RESISTOR 100 OHM 1/4W 10% COMP	01121	RCR07G101KS
R 86	0071907	RESISTOR 220 OHM 1/4W 10% COMP	01121	RCR07G221KS
R 87	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 88	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 89	0071887	RESISTOR 100 OHM 1/4W 10% COMP	01121	RCR07G101KS
R 90	0071907	RESISTOR 220 OHM 1/4W 10% COMP	01121	RCR07G221KS
R 91	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 92	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 93	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 94	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 95	0071913	RESISTOR 270 OHM 1/4W 10% COMP	01121	RCR07G271KS
R 96	0071897	RESISTOR 150 OHM 1/4W 10% COMP	01121	RCR07G151KS
R 97	0071887	RESISTOR 100 OHM 1/4W 10% COMP	01121	RCR07G101KS
R 98	0071941	RESISTOR 820 OHM 1/4W 10% COMP	01121	RCR07G821KS
R 99	0071887	RESISTOR 100 OHM 1/4W 10% COMP	01121	RCR07G101KS
R 100	0071887	RESISTOR 100 OHM 1/4W 10% COMP	01121	RCR07G101KS
R 101	0071913	RESISTOR 270 OHM 1/4W 10% COMP	01121	RCR07G271KS
R 102	0071897	RESISTOR 150 OHM 1/4W 10% COMP	01121	RCR07G151KS
R 103	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 104	0071973	RESISTOR 1.8K OHM 1/4W 10% COMP	01121	RCR07G182KS
R 105	0071920	RESISTOR 390 OHM 1/4W 10% COMP	01121	RCR07G391KS
R 106	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 107	0071907	RESISTOR 220 OHM 1/4W 10% COMP	01121	RCR07G221KS
R 108	0071901	RESISTOR 180 OHM 1/4W 10% COMP	01121	RCR07G181KS
R 109	0071894	RESISTOR 120 OHM 1/4W 10% COMP	01121	RCR07G121KS
R 110	0071894	RESISTOR 120 OHM 1/4W 10% COMP	01121	RCR07G121KS
R 111	0071901	RESISTOR 180 OHM 1/4W 10% COMP	01121	RCR07G181KS
R 112	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 113	0071901	RESISTOR 180 OHM 1/4W 10% COMP	01121	RCR07G181KS
R 114	0071894	RESISTOR 120 OHM 1/4W 10% COMP	01121	RCR07G121KS
R 115	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 116	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 117	0071887	RESISTOR 100 OHM 1/4W 10% COMP	01121	RCR07G101KS
R 118	0071920	RESISTOR 390 OHM 1/4W 10% COMP	01121	RCR07G391KS
R 119	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 120	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
T 1	0084083	XFMR MATCHING ,2-350 MHZ 50 IN 200CT OUT		T4-1

TRANSMITTER LOGIC PCB ASSEMBLY - 252908

REF DESIG PREFIX: 4651A-A1

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
U 2	0089661	IC ECL COUNTER DECADE 200-MHZ		F10137DC
U 3	0089661	IC ECL COUNTER DECADE 200-MHZ		F10137DC
U 4	0089662	IC ECL REGISTER 4-BIT SHIFT		F10141DC
U 5	0089662	IC ECL REGISTER 4-BIT SHIFT		F10141DC
U 6	0089662	IC ECL REGISTER 4-BIT SHIFT		F10141DC
U 7	0089662	IC ECL REGISTER 4-BIT SHIFT		F10141DC
U 8	0089652	IC ECL GATE OR 2-IN QUAD 3 OR-1 OR/NOR		F10103DC
U 9	0089663	IC ECL MULTIPLEXER 8 TO 1		F10164DC
U 10	0089660	IC ECL COUNTER 4-BIT BINARY 200-MHZ		F10136DC
U 11	0089652	IC ECL GATE OR 2-IN QUAD 3 OR-1 OR/NOR		F10103DC
U 12	0086633	IC ECL LINE RECEIVER QUAD		MC10115L
U 13	0088406	IC ECL FLIP-FLOP TYPE-D 160MHZ M/S DUAL		F10131DC
U 14	0088406	IC ECL FLIP-FLOP TYPE-D 160MHZ M/S DUAL		F10131DC
U 15	0089652	IC ECL GATE OR 2-IN QUAD 3 OR-1 OR/NOR		F10103DC
U 16	0088406	IC ECL FLIP-FLOP TYPE-D 160MHZ M/S DUAL		F10131DC
U 17	0089651	IC ECL GATE NOR 2-IN QUAD 3 OR-1 OR/NOR		F10102DC
U 18	0089656	IC ECL GATE EX OR/NOR 2-IN TRIPLE		F10107DC
U 19	0089663	IC ECL MULTIPLEXER 8 TO 1		F10164DC
U 20	0089660	IC ECL COUNTER 4-BIT BINARY 200-MHZ		F10136DC
U 21	0089651	IC ECL GATE NOR 2-IN QUAD 3 OR-1 OR/NOR		F10102DC
U 22	0089662	IC ECL REGISTER 4-BIT SHIFT		F10141DC
U 23	0089662	IC ECL REGISTER 4-BIT SHIFT		F10141DC
U 24	0089662	IC ECL REGISTER 4-BIT SHIFT		F10141DC
U 25	0088406	IC ECL FLIP-FLOP TYPE-D 160MHZ M/S DUAL		F10131DC
U 26	0089661	IC ECL COUNTER DECADE 200-MHZ		F10137DC
U 27	0088406	IC ECL FLIP-FLOP TYPE-D 160MHZ M/S DUAL		F10131DC
U 28	0089660	IC ECL COUNTER 4-BIT BINARY 200-MHZ		F10136DC
U 29	0089663	IC ECL MULTIPLEXER 8 TO 1		F10164DC
U 30	0089660	IC ECL COUNTER 4-BIT BINARY 200-MHZ		F10136DC
U 31	0088406	IC ECL FLIP-FLOP TYPE-D 160MHZ M/S DUAL		F10131DC
U 32	0089659	IC ECL FLIP-FLOP TYPE-JK DUAL MASTR/SLAV		F10135DC
U 33	0089656	IC ECL GATE EX OR/NOR 2-IN TRIPLE		F10107DC
U 34	0089653	IC ECL GATE AND 2-IN QUAD 3AND-1AND/NAND		F10104DC
U 35	0087800	RESISTOR NETWORK 8 220 OHM 2% 16 DIP		898-3-R220
U 36		NOT ASSIGNED		
U 37	0088406	IC ECL FLIP-FLOP TYPE-D 160MHZ M/S DUAL		F10131DC
U 38	0089661	IC ECL COUNTER DECADE 200-MHZ		F10137DC
U 39	0089661	IC ECL COUNTER DECADE 200-MHZ		F10137DC
U 40	0089661	IC ECL COUNTER DECADE 200-MHZ		F10137DC
U 41		NOT ASSIGNED		
U 42		NOT ASSIGNED		
U 43	0088406	IC ECL FLIP-FLOP TYPE-D 160MHZ M/S DUAL		F10131DC
U 44	0088406	IC ECL FLIP-FLOP TYPE-D 160MHZ M/S DUAL		F10131DC
U 45	0087800	RESISTOR NETWORK 8 220 OHM 2% 16 DIP		898-3-R220
U 46		NOT ASSIGNED		
U 47	0089661	IC ECL COUNTER DECADE 200-MHZ		F10137DC
U 48	0089661	IC ECL COUNTER DECADE 200-MHZ		F10137DC
U 49	0089661	IC ECL COUNTER DECADE 200-MHZ		F10137DC
U 50	0089661	IC ECL COUNTER DECADE 200-MHZ		F10137DC

TRANSMITTER POWER SUPPLY PCB ASSEMBLY - 220905

REF DESIG PREFIX: 4651A-A2

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
C 001	0081099	CAPACITR .0047 MF 100V CER MONO X7R 10%	72982	8121-100-X7R-472K
C 002	0081101	CAPACITR 1 MF 50V CER MONO 20%	72982	8131-050-651-105M
C 003	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	80183	T362B106M020AS
C 004	0080139	CAPACITR .1 MF 50V CER MONO =20%+80%	72982	8131-050-651-104Z
C 005	0086013	CAPACITR 22 MF 25V SOLID TANT POL 10%		T362C226K025AS
C 006	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	80183	T362B106M020AS
C 007	0084225	CAPACITR .22 MF 100V CER MONO 20%	72982	8131-100-651-224M
C 008	0081101	CAPACITR 1 MF 50V CER MONO 20%	72982	8131-050-651-105M
C 009	0081210	CAPACITR .01 MF 50V CER MONO X7R 10%	72982	8121-050-X7R-103K
C 010	0081118	CAPACITR .00598 MF 100V SILVER MICA 5%	53021	D191CXXXJ03 5980 PF
C 011	0070518	CAPACITR 100 PF 1KV CER DISC S3N 10%	71590	DD-101
C 012	0089645	CAPACITR 220 MF 60V		673D227H0XJE5C
C 013	0170264	CAPACITR 1 MF 100V CER MONO 651 20%		8141-100-651-105M
C 014	0170264	CAPACITR 1 MF 100V CER MONO 651 20%		8141-100-651-105M
C 015	0089643	CAPACITR 1000 MF 15V		672D108H015ET5C
C 016	0080139	CAPACITR .1 MF 50V CER MONO =20%+80%	72982	8131-050-651-104Z
C 017	0089644	CAPACITR 1000 MF 20V		673D108H020JE5C
C 018	0080139	CAPACITR .1 MF 50V CER MONO =20%+80%	72982	8131-050-651-104Z
C 019	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	80183	T362B106M020AS
C 020	0170263	CAPACITR 100 MF 20V		672D107H020CG5C
C 021	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	80183	T362B106M020AS
C 022	0081099	CAPACITR .0047 MF 100V CER MONO X7R 10%	72982	8121-100-X7R-472K
C 023	0081101	CAPACITR 1 MF 50V CER MONO 20%	72982	8131-050-651-105M
C 024	0081118	CAPACITR .00598 MF 100V SILVER MICA 5%	53021	D191CXXXJ03 5980 PF
C 025	0070518	CAPACITR 100 PF 1KV CER DISC S3N 10%	71590	DD-101
C 026	0081101	CAPACITR 1 MF 50V CER MONO 20%	72982	8131-050-651-105M
C 027	0081101	CAPACITR 1 MF 50V CER MONO 20%	72982	8131-050-651-105M
C 028	0170263	CAPACITR 100 MF 20V		672D107H020CG5C
C 029	0080149	CAPACITR 4.7 MF 20V SOLID TANT POL 20%	80183	196D475X0020JE3
C 030	0080149	CAPACITR 4.7 MF 20V SOLID TANT POL 20%	80183	196D475X0020JE3
C 031	0089643	CAPACITR 1000 MF 15V		672D108H015ET5C
C 032	0080139	CAPACITR .1 MF 50V CER MONO =20%+80%	72982	8131-050-651-104Z
C 033	0080139	CAPACITR .1 MF 50V CER MONO =20%+80%	72982	8131-050-651-104Z
C 034	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	80183	T362B106M020AS
C 035	0081101	CAPACITR 1 MF 50V CER MONO 20%	72982	8131-050-651-105M
CR001	0071122	DIODE 1N914 SIL 75V 75MA	80368	1N914
CR002	0071122	DIODE 1N914 SIL 75V 75MA	80368	1N914
CR003	0071122	DIODE 1N914 SIL 75V 75MA	80368	1N914
CR004	0071121	DIODE 1N821 TC REF 6.2V .01% .4W	04713	1N821
CR005	0078274	DIODE 1N4002 SIL 100V 1A	04713	1N4002
CR006	0083986	DIODE 1N4746A SI ZEN 18V 5% 1W	04713	1N4746A
CR007	0071122	DIODE 1N914 SIL 75V 75MA	80368	1N914
CR008	0071122	DIODE 1N914 SIL 75V 75MA	80368	1N914
CR009	0071142	DIODE 1N4154 SIL 25V 150MA	80368	1N4154
CR010	0078274	DIODE 1N4002 SIL 100V 1A	04713	1N4002
CR011	0078274	DIODE 1N4002 SIL 100V 1A	04713	1N4002
CR012	0089684	DIODE MR821 SIL 100V 5A FAST REC	04713	MR821
CR013	0171572	THYRISTOR SCR 200PRV 25A RMS		2N6506
CR014	0071121	DIODE 1N821 TC REF 6.2V .01% .4W	04713	1N821
CR015	0071122	DIODE 1N914 SIL 75V 75MA	80368	1N914
CR016	0071122	DIODE 1N914 SIL 75V 75MA	80368	1N914
CR017	0071122	DIODE 1N914 SIL 75V 75MA	80368	1N914
CR018	0071142	DIODE 1N4154 SIL 25V 150MA	80368	1N4154
CR019	0078274	DIODE 1N4002 SIL 100V 1A	04713	1N4002
CR020	0069679	DIODE 80SQ030 SIL 30V 8A SCHOTTKY		80SQ030
CR021	0082901	LAMP LED GRN .190 DIA .180 LNG 2.3V 20MA	31718	FLV340
CR022	0082901	LAMP LED GRN .190 DIA .180 LNG 2.3V 20MA	31718	FLV340
CR023	0078714	DIODE 1N4744A SI ZEN 15V 5% 1W	04713	1N4744A
CR024	0071143	DIODE 1N4735A SI ZEN 6.2V 5% 1W	04713	1N4735A
CR025	0071122	DIODE 1N914 SIL 75V 75MA	80368	1N914
CR026	0071122	DIODE 1N914 SIL 75V 75MA	80368	1N914
J 001	0087042	CONN RECT PIN HEADER PC BD 10 CIRCUIT		1-380991-0
J 002	0087357	CONN RECT PIN HEADER PC BD 2 CKT BLUE		6-350539-2

TRANSMITTER POWER SUPPLY PCB ASSEMBLY - 220905

REF DESIG PREFIX: 4651A-A2

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
L 001	0078841	INDUCTOR 4.7 MH MIN SHLD ENCAP 10%	72259	WEE-4700
L 002	0089688	INDUCTOR 1.5 UH FERRITE 16.2 A PC MT		3443-04
L 003	0220937	COIL ASSY 650 UHY SER 4650		
L 004	0089683	INDUCTOR 50 UH UNSHLD 10%		6310-6
L 005	0089688	INDUCTOR 1.5 UH FERRITE 16.2 A PC MT		3443-04
L 006	0078841	INDUCTOR 4.7 MH MIN SHLD ENCAP 10%	72259	WEE-4700
L 007	0220936	COIL ASSY 420 UHY SER 4650		
Q 001	0076316	TRANSSTR 2N4036 PNP SIL	79089	2N4036S
Q 002	0084113	TRANSSTR TIP 111 NPN SIL DARLINGTON PAIR	01295	TIP 111
Q 003	0077147	TRANSSTR 2N3947 NPN SIL	04713	2N3947
Q 004	0080007	TRANSSTR 2N2102 NPN SIL	79089	2N2102
Q 005	0077148	TRANSSTR 2N3251 PNP SIL	04713	2N3251
Q 006	0089669	TRANSSTR IRF132 FET N=CHNL MOS POWER		IRF132
Q 007	0081633	TRANSSTR MPS-L51 PNP SIL	04713	MPS-L51
Q 008	0077148	TRANSSTR 2N3251 PNP SIL	04713	2N3251
Q 009	0089669	TRANSSTR IRF132 FET N=CHNL MOS POWER		IRF132
Q 010	0080824	TRANSSTR 2N5415 PNP SIL	04713	2N5415
Q 011	0080824	TRANSSTR 2N5415 PNP SIL	04713	2N5415
Q 012	0078214	TRANSSTR 2N5087 PNP SIL	04713	2N5087
R 001	0072040	RESISTOR 15K OHM 1/2W 10% COMP	01121	RCR20G153KS
R 002	0071879	RESISTOR 82 OHM 1/4W 10% COMP	01121	RCR07G820KS
R 003	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	01121	RCR07G102KS
R 004	0071833	RESISTOR 6.8 OHM 1/2W 10% COMP	01121	RCR20G6R8KS
R 005	0078929	RESISTOR 1.00K OHM RN55C 1% MTL FLM		RN55C1001F
R 006	0083889	RESISTOR 1.40K OHM RN55C 1% MTL FLM		RN55C1401F
R 007	0085551	POT 5K OHM 1/2W CER 3/8 SQ HOR ADJ 20T	73138	66XR5K
R 008	0072068	RESISTOR 39K OHM 1/4W 10% COMP	01121	RCR07G393KS
R 009	0071982	RESISTOR 2.7K OHM 1/4W 10% COMP	01121	RCR07G272KS
R 010	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	01121	RCR07G472KS
R 011	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	01121	RCR07G472KS
R 012	0071941	RESISTOR 820 OHM 1/4W 10% COMP	01121	RCR07G821KS
R 013	0072026	RESISTOR 10K OHM 1/4W 10% COMP	01121	RCR07G103KS
R 014	0083907	RESISTOR 4.22K OHM RN55C 1% MTL FLM		RN55C4221F
R 015	0071989	RESISTOR 3.3K OHM 1/4W 10% COMP	01121	RCR07G332KS
R 016	0074714	RESISTOR 3.3K OHM 1/4W 5% COMP	01121	RCR07G332JS
R 017	0074675	RESISTOR 100 OHM 1/4W 5% COMP	01121	RCR07G101JS
P 018	0087584	RESISTOR .10 OHM 3W 1%		RS-2C .10 OHM 1%
R 019	0076396	RESISTOR 1.0 OHM 1/2W 10% COMP	01121	RCR20G1R0KS
R 020	0071827	RESISTOR 4.7 OHM 1W 10% COMP	01121	RCR32G47RKS
R 021	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	01121	RCR07G102KS
R 022	0078931	RESISTOR 4.99K OHM RN55C 1% MTL FLM		RN55C4991F
R 023	0088389	POT 2K OHM 1/2W CER 3/8 SQ HOR ADJ 25T		3299X-1-202
R 024	0076981	RESISTOR 5.90K OHM RN55C 1% MTL FLM		RN55C5901F
R 025	0079085	RESISTOR 100 OHM 3W WW 5%	24681	VAL-3
R 026	0079128	RESISTOR 768 OHM RN55C 1% MTL FLM		RN55C7680F
R 027	0071873	RESISTOR 56 OHM 1/4W 10% COMP	01121	RCR07G560KS
R 028	0072039	RESISTOR 15K OHM 1/4W 10% COMP	01121	RCR07G153KS
R 029	0071973	RESISTOR 1.8K OHM 1/4W 10% COMP	01121	RCR07G182KS
R 030	0085551	POT 5K OHM 1/2W CER 3/8 SQ HOR ADJ 20T	73138	66XR5K
R 031	0072068	RESISTOR 39K OHM 1/4W 10% COMP	01121	RCR07G393KS
R 032	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	01121	RCR07G472KS
R 033	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	01121	RCR07G472KS
R 034	0071973	RESISTOR 1.8K OHM 1/4W 10% COMP	01121	RCR07G182KS
R 035	0072026	RESISTOR 10K OHM 1/4W 10% COMP	01121	RCR07G103KS
R 036	0083901	RESISTOR 2.61K OHM RN55C 1% MTL FLM		RN55C2611F
R 037	0071989	RESISTOR 3.3K OHM 1/4W 10% COMP	01121	RCR07G332KS
R 038	0074714	RESISTOR 3.3K OHM 1/4W 5% COMP	01121	RCR07G332JS
R 039	0074675	RESISTOR 100 OHM 1/4W 5% COMP	01121	RCR07G101JS
R 040	0087584	RESISTOR .10 OHM 3W 1%		RS-2C .10 OHM 1%
R 041	0071939	RESISTOR 680 OHM 1/2W 10% COMP	01121	RCR20G681KS
P 042	0071862	RESISTOR 47 OHM 1/4W 10% COMP	01121	RCR07G470KS
R 043	0071907	RESISTOR 220 OHM 1/4W 10% COMP	01121	RCR07G221KS
R 044	0071939	RESISTOR 680 OHM 1/2W 10% COMP	01121	RCR20G681KS
R 045	0071901	RESISTOR 180 OHM 1/4W 10% COMP	01121	RCR07G181KS
R 046	0076275	RESISTOR 22 OHM 1/4W 10% COMP	01121	RCR07G220KS
R 047	0071907	RESISTOR 220 OHM 1/4W 10% COMP	01121	RCR07G221KS
R 048	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	01121	RCR07G102KS

TRANSMITTER POWER SUPPLY PCB ASSEMBLY - 220905

REF DESIG PREFIX: 4651A-A2

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
R 049	0071989	RESISTOR 3.3K OHM 1/4W 10% COMP	01121	RCR07G332KS
R 050	0071867	RESISTOR 50 OHM 3W WW 5%	24681	VAL3
R 051	0083038	RESISTOR 6.81K OHM RN55C 1% MTL FLM		RN55C6811F
R 052	0079104	RESISTOR 5.36K OHM RN55C 1% MTL FLM		RN55C5361F
R 053	0072039	RESISTOR 15K OHM 1/4W 10% COMP	01121	RCR07G153KS
R 054	0071857	RESISTOR 33 OHM 1/4W 10% COMP	01121	RCR07G330KS
R 055	0072019	RESISTOR 8.2K OHM 1/4W 10% COMP	01121	RCR07G822KS
R 056	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	01121	RCR07G222KS
TP001	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	00779	60599-1
TP002	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	00779	60599-1
TP003	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	00779	60599-1
TP004	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	00779	60599-1
TP005	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	00779	60599-1
U 001	0085993	IC VLTG RGLTR/PW MOD 70C 16L-DIP		SG3524
U 002	0084890	IC OP AMP 8L-DIP 70C COMP	741C 04713	MC1741CP1
U 003	0085993	IC VLTG RGLTR/PW MOD 70C 16L-DIP		SG3524
U 004	0084890	IC OP AMP 8L-DIP 70C COMP	741C 04713	MC1741CP1

TRANSMITTER OUTPUT AMPLIFIER PCB ASSEMBLY - 220908

REF DESIG PREFIX: 4651A-A3

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
C 001	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 002	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 003	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	80183	T362B106M020AS
C 004	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 005	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 006	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 007	0082007	CAPACITR 4.3 PF 100V CER DISC COH +/- .25P	72982	835-024-COHO-439C
C 008	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 009	0082014	CAPACITR 8.2 PF 100V CER DISC COH +/- .25P	72982	835-024-COHO-829C
C 010	0083258	CAPACITR CHIP .1 MF 50V		C1813C104M5XAH
C 011	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 012	0078700	FACTORY SELECTED VALUE		
C 013	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 014	0083258	CAPACITR CHIP .1 MF 50V		C1813C104M5XAH
C 015	0076381	CAPACITR 1.5 PF 500V CER TUBULAR	00656	CC20CK1R5C
C 016	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 017	0082004	CAPACITR 3.3 PF 100V CER DISC COJ +/- .25P	72982	835-024-COJO-339C
C 018	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 019	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 020	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 021	0083258	CAPACITR CHIP .1 MF 50V		C1813C104M5XAH
C 022	0076381	CAPACITR 1.5 PF 500V CER TUBULAR	00656	CC20CK1R5C
C 023	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 024	0082004	CAPACITR 3.3 PF 100V CER DISC COJ +/- .25P	72982	835-024-COJO-339C
C 025	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 026	0083258	CAPACITR CHIP .1 MF 50V		C1813C104M5XAH
C 027	0076381	CAPACITR 1.5 PF 500V CER TUBULAR	00656	CC20CK1R5C
C 028	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 029	0082004	CAPACITR 3.3 PF 100V CER DISC COJ +/- .25P	72982	835-024-COJO-339C
C 030	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 031	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 032	0083258	CAPACITR CHIP .1 MF 50V		C1813C104M5XAH
C 033	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 034	0076381	CAPACITR 1.5 PF 500V CER TUBULAR	00656	CC20CK1R5C
C 035	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 036	0082004	CAPACITR 3.3 PF 100V CER DISC COJ +/- .25P	72982	835-024-COJO-339C
C 037	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 038	0082003	CAPACITR 2.7 PF 100V CER DISC COJ +/- .25P	72982	835-024-COJO-279C
C 039	0081929	CAPACITR 13 PF 500V CER DISC COG 5%	72982	831-COJO-130J
C 040	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 041	0081252	CAPACITR 120PF 1KV CER DISC S3N 10%	71590	DD121
C 042	0081934	CAPACITR 18 PF 100V CER DISC COG 5%	72982	835-COJO-180J
C 043	0070475	CAPACITR 12 PF 1 KV CER DISC S2L 10%	71590	DD=120
C 044	0035761	CAPACITR 5.0 PF 500V CER DISC COH +/- .25P	72982	831-COHO-509C
C 045	0081125	CAPACITR .25-1.5 PF TEFLON TRIMMER PC MT	72982	530-000
C 046	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 047	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 048	0083258	CAPACITR CHIP .1 MF 50V		C1813C104M5XAH
C 049	0076381	CAPACITR 1.5 PF 500V CER TUBULAR	00656	CC20CK1R5C
C 050	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 051	0082004	CAPACITR 3.3 PF 100V CER DISC COJ +/- .25P	72982	835-024-COJO-339C
C 052	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 053	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 054	0083258	CAPACITR CHIP .1 MF 50V		C1813C104M5XAH
C 055	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 056	0076381	CAPACITR 1.5 PF 500V CER TUBULAR	00656	CC20CK1R5C
C 057	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 058	0082004	CAPACITR 3.3 PF 100V CER DISC COJ +/- .25P	72982	835-024-COJO-339C
C 059	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 060	0070544	CAPACITR .001 MF 1KV CER DISC Z5F 10%	71590	DD102
C 061	0070544	CAPACITR .001 MF 1KV CER DISC Z5F 10%	71590	DD102
C 062	0070544	CAPACITR .001 MF 1KV CER DISC Z5F 10%	71590	DD102
C 063	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z

TRANSMITTER OUTPUT AMPLIFIER PCB ASSEMBLY - 220908

REF DESIG PREFIX: 4651A-A3

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
C 064	0070544	CAPACITR .001 MF 1KV CER DISC Z5F 10%	71590	DD102
C 065	0080139	CAPACITR .1 MF 50V CER MONO =20%+80%	72982	8131-050-651-104Z
C 066	0080139	CAPACITR .1 MF 50V CER MONO =20%+80%	72982	8131-050-651-104Z
C 067	0080139	CAPACITR .1 MF 50V CER MONO =20%+80%	72982	8131-050-651-104Z
C 068	0080139	CAPACITR .1 MF 50V CER MONO =20%+80%	72982	8131-050-651-104Z
C 069	0080139	CAPACITR .1 MF 50V CER MONO =20%+80%	72982	8131-050-651-104Z
C 070	0080139	CAPACITR .1 MF 50V CER MONO =20%+80%	72982	8131-050-651-104Z
C 071	0080139	CAPACITR .1 MF 50V CER MONO =20%+80%	72982	8131-050-651-104Z
C 072	0080148	CAPACITR 10 MF 20V SOLID TANT POL 20%	R0183	T362B106M020AS
C 073	0080139	CAPACITR .1 MF 50V CER MONO =20%+80%	72982	8131-050-651-104Z
C 074	0080139	CAPACITR .1 MF 50V CER MONO =20%+80%	72982	8131-050-651-104Z
C 075	0081099	CAPACITR .0047 MF 100V CER MONO X7R 10%	72982	8121-100-X7R-472K
C 076	0080139	CAPACITR .1 MF 50V CER MONO =20%+80%	72982	8131-050-651-104Z
C 077	0086013	CAPACITR 22 MF 25V SOLID TANT POL 10%		T362C226K025AS
C 078	0170263	CAPACITR 100 MF 20V		672D107H020CG5C
C 079	0070544	CAPACITR .001 MF 1KV CER DISC Z5F 10%	71590	DD102
C 080	0073486	CAPACITR 1 PF 500V CER TUBULAR	00656	CC20CK010C
CR001	0071142	DIODE 1N4154 SIL 25V 150MA	80368	1N4154
CR002	0071142	DIODE 1N4154 SIL 25V 150MA	80368	1N4154
CR003	0071122	DIODE 1N914 SIL 75V 75MA	80368	1N914
CR004	0081787	DIODE 1N4607 FAST RECOVERY 70V 400 MA	13715	1N4607
CR005	0086018	RECTIFIER ASSY 200V 2A FAST REC.200 NSEC		S2F
CR006	0076524	DIODE 1N752A SI ZEN 5.6V 5% .4W	04713	1N752A
CR007	0071142	DIODE 1N4154 SIL 25V 150MA	80368	1N4154
CR008	0071142	DIODE 1N4154 SIL 25V 150MA	80368	1N4154
E 001	0081718	CORE BEAD FERRITE 7D .138X.037X.150L GRN	78488	57-1413
J 001	0087043	CONN RECT PIN HEADER PC BD 3 CIRCUIT		350541-1
J 002	0087034	CONN HEADER DBL ROW STRAIGHT 10-PIN PC		87478-2
J 003	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 004	0085125	CONN HEADER DBL ROW STRAIGHT 4-PIN PC	00779	87227-2
J 005	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 006	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 007	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 008	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 009	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 010	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 011	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 012	0087367	CONN HEADER SGL ROW STRAIGHT 4-PIN PC		87220-4
J 013	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 014	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 015	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 016	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 017	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 018	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 019	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 020	0084940	CONN COAX SMB MALE PC MT 75 OHM	98291	51-151-0000
J 021	0085126	CONN HEADER DBL ROW STRAIGHT 10-PIN PC	00779	87227-5
K 001	0085285	RELAY 12VDC TO-5 PKG		732-12
K 002	0085285	RELAY 12VDC TO-5 PKG		732-12
L 001	0087293	INDUCTOR 100 UH FERRITE CHOKE 10%		6470-10
L 002	0079926	INDUCTOR 10 UH SUBMIN UNSHLD 10%	91637	IR-2
L 003	0079926	INDUCTOR 10 UH SUBMIN UNSHLD 10%	91637	IR-2
L 004	0078038	INDUCTOR 2.2 UH SUBMIN UNSHLD 10%	91637	IR-2
L 005	0078038	INDUCTOR 2.2 UH SUBMIN UNSHLD 10%	91637	IR-2
L 006	0078038	INDUCTOR 2.2 UH SUBMIN UNSHLD 10%	91637	IR-2
L 007	0078038	INDUCTOR 2.2 UH SUBMIN UNSHLD 10%	91637	IR-2

TRANSMITTER OUTPUT AMPLIFIER PCB ASSEMBLY - 220908

REF DESIG PREFIX: 4651A-A3

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
L 008	0078038	INDUCTOR 2,2 UH SUBMIN UNSHLD 10%	91637	IR-2
L 009	0078038	INDUCTOR 2,2 UH SUBMIN UNSHLD 10%	91637	IR-2
L 010	0078038	INDUCTOR 2,2 UH SUBMIN UNSHLD 10%	91637	IR-2
L 011	0078038	INDUCTOR 2,2 UH SUBMIN UNSHLD 10%	91637	IR-2
L 012	0078038	INDUCTOR 2,2 UH SUBMIN UNSHLD 10%	91637	IR-2
L 013	0079926	INDUCTOR 10 UH SUBMIN UNSHLD 10%	91637	IR-2
L 014	0078046	INDUCTOR 3,3 UH SUBMIN UNSHLD 10%	91637	IR-2
L 015	0078046	INDUCTOR 3,3 UH SUBMIN UNSHLD 10%	91637	IR-2
L 016	0078046	INDUCTOR 3,3 UH SUBMIN UNSHLD 10%	91637	IR-2
L 017	0078046	INDUCTOR 3,3 UH SUBMIN UNSHLD 10%	91637	IR-2
L 018	0078046	INDUCTOR 3,3 UH SUBMIN UNSHLD 10%	91637	IR-2
L 019	0078046	INDUCTOR 3,3 UH SUBMIN UNSHLD 10%	91637	IR-2
L 020	0087293	INDUCTOR 100 UH FERRITE CHOKE 10%		6470-10
L 021	0220935	COIL ASSY 2.0 MH		
L 022	0087293	INDUCTOR 100 UH FERRITE CHOKE 10%		6470-10
P 001	0086884	JUMPER FEMALE INSULATED .10 SPACING		65474-004
P 002	0086884	JUMPER FEMALE INSULATED .10 SPACING		65474-004
P 003	0086884	JUMPER FEMALE INSULATED .10 SPACING		65474-004
P 004	0086884	JUMPER FEMALE INSULATED .10 SPACING		65474-004
Q 001	0077148	TRANSSTR 2N3251 PNP SIL	04713	2N3251
Q 002	0077148	TRANSSTR 2N3251 PNP SIL	04713	2N3251
Q 003	0075091	TRANSSTR 2N2857 NPN SIL	04713	2N2857
Q 004	0085042	TRANSSTR MRF 517 NPN SIL	04713	MRF 517
Q 005	0075091	TRANSSTR 2N2857 NPN SIL	04713	2N2857
Q 006	0085042	TRANSSTR MRF 517 NPN SIL	04713	MRF 517
Q 007	0075091	TRANSSTR 2N2857 NPN SIL	04713	2N2857
Q 008	0085042	TRANSSTR MRF 517 NPN SIL	04713	MRF 517
Q 009	0075091	TRANSSTR 2N2857 NPN SIL	04713	2N2857
Q 010	0085042	TRANSSTR MRF 517 NPN SIL	04713	MRF 517
Q 011	0075091	TRANSSTR 2N2857 NPN SIL	04713	2N2857
Q 012	0085042	TRANSSTR MRF 517 NPN SIL	04713	MRF 517
Q 013	0075091	TRANSSTR 2N2857 NPN SIL	04713	2N2857
Q 014	0075091	TRANSSTR 2N2857 NPN SIL	04713	2N2857
Q 015	0075091	TRANSSTR 2N2857 NPN SIL	04713	2N2857
Q 016	0085042	TRANSSTR MRF 517 NPN SIL	04713	MRF 517
Q 017	0075091	TRANSSTR 2N2857 NPN SIL	04713	2N2857
Q 018	0085042	TRANSSTR MRF 517 NPN SIL	04713	MRF 517
Q 019	0073140	TRANSSTR 2N2270 NPN SIL	79089	2N2270
R 001	0071836	RESISTOR 10 OHM 1/4W 10% COMP	01121	RCR07G100KS
R 002	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	01121	RCR07G472KS
R 003	0071836	RESISTOR 10 OHM 1/4W 10% COMP	01121	RCR07G100KS
R 004	0072002	RESISTOR 4.7K OHM 1/4W 10% COMP	01121	RCR07G472KS
R 005	0071901	RESISTOR 180 OHM 1/4W 10% COMP	01121	RCR07G181KS
R 006	0085745	RESISTOR 68.1 OHM RN55C 1% MTL FLM		RN55C68R1F
R 007	0071926	RESISTOR 470 OHM 1/4W 10% COMP	01121	RCR07G471KS
R 008	0071862	RESISTOR 47 OHM 1/4W 10% COMP	01121	RCR07G470KS
R 009	0071901	RESISTOR 180 OHM 1/4W 10% COMP	01121	RCR07G181KS
R 010	0071887	RESISTOR 100 OHM 1/4W 10% COMP	01121	RCR07G101KS
R 011	0071913	RESISTOR 270 OHM 1/4W 10% COMP	01121	RCR07G271KS
R 012	0084489	POT 100 OHM 1/2W CER .30 DIA VERT ADJ 4T	80294	3339P-1-101
R 013	0071914	RESISTOR 270 OHM 1/2W 10% COMP	01121	RCR20G271KS
R 014	0079123	RESISTOR 301 OHM RN55C 1% MTL FLM		RN55C3010F
R 015	0071920	RESISTOR 390 OHM 1/4W 10% COMP	01121	RCR07G391KS
R 016	0071862	RESISTOR 47 OHM 1/4W 10% COMP	01121	RCR07G470KS
R 017	0071907	RESISTOR 220 OHM 1/4W 10% COMP	01121	RCR07G221KS
R 018	0071879	RESISTOR 82 OHM 1/4W 10% COMP	01121	RCR07G820KS
R 019	0083879	RESISTOR 619 OHM RN55C 1% MTL FLM		RN55C6190F
R 020	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 021	0083089	RESISTOR 75.0 OHM RN55C 1% MTL FLM		RN55C75R0F
R 022	0079123	RESISTOR 301 OHM RN55C 1% MTL FLM		RN55C3010F
R 023	0071920	RESISTOR 390 OHM 1/4W 10% COMP	01121	RCR07G391KS
R 024	0071862	RESISTOR 47 OHM 1/4W 10% COMP	01121	RCR07G470KS

TRANSMITTER OUTPUT AMPLIFIER PCB ASSEMBLY - 220908

REF DESIG PREFIX: 4651A-A3

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
R 025	0071907	RESISTOR 220 OHM 1/4W 10% COMP	01121	RCR07G221KS
R 026	0071879	RESISTOR 82 OHM 1/4W 10% COMP	01121	RCR07G820KS
R 027	0083879	RESISTOR 619 OHM RN55C 1% MTL FLM		RN55C6190F
R 028	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 029	0083089	RESISTOR 75.0 OHM RN55C 1% MTL FLM		RN55C75R0F
R 030	0083800	RESISTOR 115 OHM RN55C 1% MTL FLM		RN55C1150F
R 031	0083800	RESISTOR 115 OHM RN55C 1% MTL FLM		RN55C1150F
R 032	0083087	RESISTOR 61.9 OHM RN55C 1% MTL FLM		RN55C619R9F
R 033	0083800	RESISTOR 115 OHM RN55C 1% MTL FLM		RN55C1150F
R 034	0079123	RESISTOR 301 OHM RN55C 1% MTL FLM		RN55C3010F
R 035	0071921	RESISTOR 390 OHM 1/2W 10% COMP	01121	RCR20G391KS
R 036	0071862	RESISTOR 47 OHM 1/4W 10% COMP	01121	RCR07G470KS
R 037	0071907	RESISTOR 220 OHM 1/4W 10% COMP	01121	RCR07G221KS
R 038	0071879	RESISTOR 82 OHM 1/4W 10% COMP	01121	RCR07G820KS
R 039	0083879	RESISTOR 619 OHM RN55C 1% MTL FLM		RN55C6190F
R 040	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 041	0083089	RESISTOR 75.0 OHM RN55C 1% MTL FLM		RN55C75R0F
R 042	0079123	RESISTOR 301 OHM RN55C 1% MTL FLM		RN55C3010F
R 043	0071920	RESISTOR 390 OHM 1/4W 10% COMP	01121	RCR07G391KS
R 044	0071862	RESISTOR 47 OHM 1/4W 10% COMP	01121	RCR07G470KS
R 045	0071907	RESISTOR 220 OHM 1/4W 10% COMP	01121	RCR07G221KS
R 046	0071879	RESISTOR 82 OHM 1/4W 10% COMP	01121	RCR07G820KS
R 047	0083879	RESISTOR 619 OHM RN55C 1% MTL FLM		RN55C6190F
R 048	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 049	0083089	RESISTOR 75.0 OHM RN55C 1% MTL FLM		RN55C75R0F
R 050	0076723	RESISTOR 39 OHM 1/4W 10% COMP	01121	RCR07G390KS
R 051	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	01121	RCR07G102KS
R 052	0071862	RESISTOR 47 OHM 1/4W 10% COMP	01121	RCR07G470KS
R 053	0083089	RESISTOR 75.0 OHM RN55C 1% MTL FLM		RN55C75R0F
R 054	0083091	RESISTOR 140 OHM RN55C 1% MTL FLM		RN55C1400F
R 055	0083801	RESISTOR 150 OHM RN55C 1% MTL FLM		RN55C1500F
R 056	0071876	RESISTOR 68 OHM 1/4W 10% COMP	01121	RCR07G680KS
R 057	0083097	RESISTOR 332 OHM RN55C 1% MTL FLM		RN55C3320F
R 058	0078927	RESISTOR 1.65K OHM RN55C 1% MTL FLM		RN55C1651F
R 059	0083887	RESISTOR 1.27K OHM RN55C 1% MTL FLM		RN55C1271F
R 060	0083858	RESISTOR 133 OHM RN55C 1% MTL FLM		RN55C1330F
R 061	0079010	RESISTOR 590 OHM RN55C 1% MTL FLM		RN55C5900F
R 062	0079123	RESISTOR 301 OHM RN55C 1% MTL FLM		RN55C3010F
R 063	0071920	RESISTOR 390 OHM 1/4W 10% COMP	01121	RCR07G391KS
R 064	0071862	RESISTOR 47 OHM 1/4W 10% COMP	01121	RCR07G470KS
R 065	0071907	RESISTOR 220 OHM 1/4W 10% COMP	01121	RCR07G221KS
R 066	0071879	RESISTOR 82 OHM 1/4W 10% COMP	01121	RCR07G820KS
R 067	0083879	RESISTOR 619 OHM RN55C 1% MTL FLM		RN55C6190F
R 068	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 069	0083089	RESISTOR 75.0 OHM RN55C 1% MTL FLM		RN55C75R0F
R 070	0079123	RESISTOR 301 OHM RN55C 1% MTL FLM		RN55C3010F
R 071	0071920	RESISTOR 390 OHM 1/4W 10% COMP	01121	RCR07G391KS
R 072	0071862	RESISTOR 47 OHM 1/4W 10% COMP	01121	RCR07G470KS
R 073	0071907	RESISTOR 220 OHM 1/4W 10% COMP	01121	RCR07G221KS
R 074	0071879	RESISTOR 82 OHM 1/4W 10% COMP	01121	RCR07G820KS
R 075	0083879	RESISTOR 619 OHM RN55C 1% MTL FLM		RN55C6190F
R 076	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 077	0083089	RESISTOR 75.0 OHM RN55C 1% MTL FLM		RN55C75R0F
R 078	0083089	RESISTOR 75.0 OHM RN55C 1% MTL FLM		RN55C75R0F
R 079	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 080	0071918	RESISTOR 330 OHM 1/4W 10% COMP	01121	RCR07G331KS
R 081	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 082	0079318	RESISTOR 121 OHM RN55C 1% MTL FLM		RN55C1210F
R 083	0078912	RESISTOR 196 OHM RN55C 1% MTL FLM		RN55C1960F
R 084	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 085	0071926	RESISTOR 470 OHM 1/4W 10% COMP	01121	RCR07G471KS
R 086	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 087	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 088	0071926	RESISTOR 470 OHM 1/4W 10% COMP	01121	RCR07G471KS

TRANSMITTER OUTPUT AMPLIFIER PCB ASSEMBLY - 220908

REF DESIG PREFIX: 4651A-A3

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
R 089	0079318	RESISTOR 121 OHM RN55C 1% MTL FLM		RN55C1210F
R 090	0078912	RESISTOR 196 OHM RN55C 1% MTL FLM		RN55C1960F
R 091	0071926	RESISTOR 470 OHM 1/4W 10% COMP	01121	RCR07G471KS
R 092	0079318	RESISTOR 121 OHM RN55C 1% MTL FLM		RN55C1210F
R 093	0078912	RESISTOR 196 OHM RN55C 1% MTL FLM		RN55C1960F
R 094	0071931	RESISTOR 560 OHM 1/4W 10% COMP	01121	RCR07G561KS
R 095	0071926	RESISTOR 470 OHM 1/4W 10% COMP	01121	RCR07G471KS
R 096	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	01121	RCR07G222KS
R 097	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	01121	RCR07G222KS
R 098	0071941	RESISTOR 820 OHM 1/4W 10% COMP	01121	RCR07G821KS
R 099	0087836	POT 500 OHM 1/2W CER 3/8 SQ VERT ADJ 25T		3299W-1-501
R 100	0071897	RESISTOR 150 OHM 1/4W 10% COMP	01121	RCR07G151KS
R 101	0078931	RESISTOR 4.99K OHM RN55C 1% MTL FLM		RN55C4991F
R 102	0071926	RESISTOR 470 OHM 1/4W 10% COMP	01121	RCR07G471KS
R 103	0071926	RESISTOR 470 OHM 1/4W 10% COMP	01121	RCR07G471KS
R 104	0071907	RESISTOR 220 OHM 1/4W 10% COMP	01121	RCR07G221KS
R 105	0075539	RESISTOR 1.2 OHM 1/2W 10% COMP	01121	RCR20G1R2KS
R 106	0071897	RESISTOR 150 OHM 1/4W 10% COMP	01121	RCR07G151KS
R 107	0071901	RESISTOR 180 OHM 1/4W 10% COMP	01121	RCR07G181KS
TP001	0082909	TERMINAL PRESS MT DISCONNECT .058 PIN	00779	60599-1
U 001	0220984	OSCILATR 44.736 MHZ CRYSTAL TEMP COMP		
U 002	0086633	IC ECL LINE RECEIVER QUAD		MC10115L
U 003	0084658	IC ECL GATE NOR 2-IN QUAD	04713	MC10102P
U 004	0088405	IC ECL TRANSLATOR ECL/TTL QUAD		F10125DC
U 005	0087694	IC TTL BUFFER NAND 4-IN DUAL		SN74S140J
U 006	0087694	IC TTL BUFFER NAND 4-IN DUAL		SN74S140J
U 007	0085993	IC VLTG RGLTR/PW MOD 70C 16L-DIP		SG3524

TRANSMITTER FRONT PANEL ASSEMBLY - 252909

REF DESIG PREFIX: 4651A-A4

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
A 1	0252905	PWB ASSY FRONT PNL XMTR MDL 4651A		
W 1	0220958	CABLE ASSY,DS=3 OUTPUT MDL 4651		
W 2	0220959	CABLE ASSY,DS=3 OUTPUT MDL4651		
W 3	0220960	CABLE ASSY,DS=3 OUTPUT MDL 4651		
W 4	0220961	CABLE ASSY,DS=3 OUTPUT MDL 4651		
W 5	0220962	CABLE ASSY,DS=3 OUTPUT MDL 4651		
W 6	0220963	CABLE ASSY DS=3 OUTPUT MDL 4651		
W 11	0220968	CABLE ASSY DATA OUTPUT MDL 4651		
W 12	0220969	CABLE ASSY CLOCK OUTPUT MDL 4651		
W 13	0220970	CABLE ASSY M=SYNC OUTPUT MDL 4651		
W 14	0220971	CABLE ASSY CLOCK INPUT MDL 4651		
W 15	0220956	CABLE ASSY FRONT PNL ANAL INTEFC MDL 4651		
W 16	0220957	CABLE ASSY,FRONT PNL DIG INTEFC MDL 4651		

TRANSMITTER FRONT PANEL PCB ASSEMBLY - 252905

REF DESIG PREFIX: 4651A-A4A1

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
C 1	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 2	0086013	CAPACITR 22 MF 25V SOLID TANT POL 10%		T362C226K025AS
C 3	0080139	CAPACITR .1 MF 50V CER MONO -20%+80%	72982	8131-050-651-104Z
C 4	0086013	CAPACITR 22 MF 25V SOLID TANT POL 10%		T362C226K025AS
DS 1	0089614	LAMP LED RED .123 DIA .105 LNG 2.0V 20MA		MV5777C
DS 2	0089614	LAMP LED RED .123 DIA .105 LNG 2.0V 20MA		MV5777C
DS 3	0089614	LAMP LED RED .123 DIA .105 LNG 2.0V 20MA		MV5777C
J 1	0087451	CONN HEADER DBL ROW STRAIGHT 26-PIN PC		87478-4
J 2	0087034	CONN HEADER DBL ROW STRAIGHT 10-PIN PC		87478-2
Q 1	0077148	TRANSSTR 2N3251 PNP SIL	04713	2N3251
Q 2	0077148	TRANSSTR 2N3251 PNP SIL	04713	2N3251
R 1	0071907	RESISTOR 220 OHM 1/4W 10% COMP	01121	RCR07G221KS
R 2	0071926	RESISTOR 470 OHM 1/4W 10% COMP	01121	RCR07G471KS
R 3	0071913	RESISTOR 270 OHM 1/4W 10% COMP	01121	RCR07G271KS
R 4	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	01121	RCR07G102KS
R 5	0071901	RESISTOR 180 OHM 1/4W 10% COMP	01121	RCR07G181KS
R 6	0071913	RESISTOR 270 OHM 1/4W 10% COMP	01121	RCR07G271KS
R 7	0071951	RESISTOR 1.0K OHM 1/4W 10% COMP	01121	RCR07G102KS
R 8	0071901	RESISTOR 180 OHM 1/4W 10% COMP	01121	RCR07G181KS
R 9	0071926	RESISTOR 470 OHM 1/4W 10% COMP	01121	RCR07G471KS
R 10	0071977	RESISTOR 2.2K OHM 1/4W 10% COMP	01121	RCR07G222KS
S 1	0220942	SWITCH ASSY OUTPUT LEVEL BERTS XMTR 4651		
S 2	0252911	SWITCH ASSY OUTPUT XMTR MDL 4651A		
S 3	0220944	SWITCH ASSY ERROR RATE BERTS XMTR 4651		
S 4	0220945	SWITCH ASSY CLOCK BERTS XMTR MDL 4651		
U 1	0089651	IC ECL GATE NOR 2-IN QUAD 3 OR-1 OR/NOR		F10102DC
U 2	0089651	IC ECL GATE NOR 2-IN QUAD 3 OR-1 OR/NOR		F10102DC
U 3	0087319	RESISTOR NETWORK 7 2.2K OHM 10% 8 SIP		4308R-101-222L
U 4	0087319	RESISTOR NETWORK 7 2.2K OHM 10% 8 SIP		4308R-101-222L

TRANSMITTER REAR PANEL ASSEMBLY - 220950 ①

REF DESIG PREFIX: 4651A-A5

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
	0254746	POWER WIRING HARNESS SERIES 4650		
	0158002	FILTER,FAN		
	0158041	RETAINER,SCREEN,MODEL 4647		
	0071220	FUSE 1 AMP SLO BLO	75915	3AG 313001.
	0079833	GUARD FINGER FAN	82877	20049
A 1	0220902	PWB ASSY RECTIFIER & FILTER SER 4650		
B 1	0220951	FAN ASSY SERIES 4650		
F 1	0071228	FUSE 3 AMP SLO BLO	75915	3AG 313003.
T 1	0220887	TRANSFORMER PWR BERTS XMTR MDL 4651		

① APPLIES TO UNITS WITH SERIAL NUMBERS 10 AND BELOW (APPROXIMATELY)

TRANSMITTER REAR PANEL ASSEMBLY - 252842 ②

REF DESIG PREFIX: 4651A-A5

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
	0252843	PWR WIRING HARNESS BERTS XMTR MDL 4651A		
	0158002	FILTER,FAN		
	0158041	RETAINER,SCREEN,MODEL 4647		
	0079833	GUARD FINGER FAN	82877	20049
	0071220	FUSE 1 AMP SLO BLO	75915	3AG 313001.
A 1	0252781	PWB ASSY RECTIFIER & FILTER AC/DC BERTS		
B 1	0220951	FAN ASSY SERIES 4650		
T 1	0220887	TRANSFORMER PWR BERTS XMTR MDL 4651		

② APPLIES TO UNITS WITH SERIAL NUMBERS 11 AND ABOVE (APPROXIMATELY)

TRANSMITTER RECTIFIER AND FILTER PCB ASSEMBLY - 220902 (1)

REF DESIG PREFIX: 4651A-A5A1

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
C 1	0075417	CAPACITR .01 MF 150V CER DISC Z5V-40+60%	71590	DDM-103
C 2	0089646	CAPACITR 33 MF 100V		672D336H100EK5C
C 3	0089646	CAPACITR 33 MF 100V		672D336H100EK5C
C 4	0171550	CAPACITR 1600 MF 75V		3050HP162U075JM
C 5	0171550	CAPACITR 1600 MF 75V		3050HP162U075JM
CR 1	0081865	DIODE 1N4999 SIL 200V 3A PC MOUNT	04713	1N4999
CR 2	0089680	RECTIFIER ASSY 200V 10A		PY20-WIRE LEADS
CR 3	0089680	RECTIFIER ASSY 200V 10A		PY20-WIRE LEADS
F 1	0084000	VARIES WITH MODEL, SEE HIGHER ASSY FOR PN		
F 2	0071236	FUSE 10 AMP 250 VOLT	75915	3AB 314010.
J 1	0089690	CONN RECT SOCKET HEADER ASSY 3 CIRCUITS		350760-4
J 2	0087461	CONN RECT PIN HEADER PC BD 4 CIRCUIT		350543-1
J 3	0087351	CONN RECT PIN HEADER PC BD 2 CIRCUIT		350539-2
L 1	0170266	INDUCTOR 47 UH CHOKE 4 AMPS		RL-1283-47
L 2	0170266	INDUCTOR 47 UH CHOKE 4 AMPS		RL-1283-47

(1) APPLIES TO UNITS WITH SERIAL NUMBERS 10 AND BELOW (APPROXIMATELY)

TRANSMITTER RECTIFIER AND FILTER PCB ASSEMBLY - 252781 (2)

REF DESIG PREFIX: 4651A-A5A1

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
C 1	0075417	CAPACITR .01 MF 150V CER DISC Z5V-40+60%	71590	DDM-103
C 2	0089646	CAPACITR 33 MF 100V		672D336H100EK5C
C 3	0089646	CAPACITR 33 MF 100V		672D336H100EK5C
C 4	0171550	CAPACITR 1600 MF 75V		3050HP162U075JM
C 5	0171550	CAPACITR 1600 MF 75V		3050HP162U075JM
C 6	0170264	CAPACITR 1 MF 100V CER MONO 651 20%		8141-100-651-105M
CR 1	0081865	DIODE 1N4999 SIL 200V 3A PC MOUNT	04713	1N4999
CR 2	0089680	RECTIFIER ASSY 200V 10A		PY20-WIRE LEADS
CR 3	0089680	RECTIFIER ASSY 200V 10A		PY20-WIRE LEADS
CR 4	0083986	DIODE 1N4746A SI ZEN 18V 5% 1W	04713	1N4746A
F 1	0071232	FUSE 5 AMP SLO BLD	75915	3AG 313005.
F 2	0071236	FUSE 10 AMP 250 VOLT	75915	3AB 314010.
J 1	0089690	CONN RECT SOCKET HEADER ASSY 3 CIRCUITS		350760-4
J 2	0082769	CONN RECT PIN HEADER PC BD 6 CIRCUIT	00779	1-380999-0
J 3	0087351	CONN RECT PIN HEADER PC BD 2 CIRCUIT		350539-2
L 1	0170266	INDUCTOR 47 UH CHOKE 4 AMPS		RL-1283-47
L 2	0170266	INDUCTOR 47 UH CHOKE 4 AMPS		RL-1283-47
O 1	0089669	TRANSSTR IRF132 FET N-CHNL MOS POWER		IRF132
R 1	0072214	RESISTOR 4.7 MEG 1/4W 10% COMP	01121	RCR07G475KS

(2) APPLIES TO UNITS WITH SERIAL NUMBERS 11 AND ABOVE (APPROXIMATELY)

TRANSMITTER CURRENT LIMITER ASSEMBLY - 254965 (1)

REF DESIG PREFIX: 4651A-A6

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
C 1	0170264	CAPACITR 1 MF 100V CER MONO 651 20%		8141-100-651-105M
CR 1	0083986	DIODE 1N4746A SI ZEN 18V 5% 1W	04713	1N4746A
Q 1	0089669	TRANSSTR IRF132 FET N-CHNL MOS POWER		IRF132
R 1	0072123	RESISTOR 150K OHM 1/4W 10% COMP	01121	RCR07G154KS
W 1	0254745	CABLE ASSY CARD RETAINER/CURRENT LIM.		

(1) APPLIES TO UNITS WITH SERIAL NUMBERS 14 AND BELOW (APPROXIMATELY)

TRANSMITTER CURRENT LIMITER ASSEMBLY - 252965 (2)

REF DESIG PREFIX: 4651A-A6

REF DESIG	PART NO.	DESCRIPTION	FSCM CODE	VENDOR PART NUMBER
C 1	0170264	CAPACITR 1 MF 100V CER MONO 651 20%		8141-100-651-105M
CR 1	0083986	DIODE 1N4746A SI ZEN 18V 5% 1W	04713	1N4746A
Q 1	0089669	TRANSSTR IRF132 FET N-CHNL MOS POWER		IRF132
R 1	0072214	RESISTOR 4.7 MEG 1/4W 10% COMP	01121	RCR07G475KS

(2) APPLIES TO UNITS WITH SERIAL NUMBERS 15 AND ABOVE (APPROXIMATELY)

FSCM - MANUFACTURER CROSS REFERENCE

FSCM	MANUFACTURER	CITY	STATE
00656	AEROVOX CORPORATION	NEW BEDFORD	MASS
00779	AMP INC	HARRISBURG	PA
01121	ALLEN-BRADLEY CO	MILWAUKEE	WISC
01295	TEXAS INSTRUMENTS INC	DALLAS	TEXAS
04713	MOTOROLA SEMICONDUCTOR PDTS	PHOENIX	ARIZ
05397	KEMET DIV-UNION CARBIDE	CLEVELAND	OHIO
13715	FAIRCHILD SEMICONDUCTOR CORP	SAN RAFAEL	CALIF
24446	GENERAL ELECTRIC CO	SCHENECTADY	NY
24681	MEMCOR INC COMPONENTS DIV/TRU-OHM	HUNINGTON	IND
31718	FAIRCHILD MICROWAVE PRODUCTS	MOUNTAIN VIEW	CALIF
53021	SANGAMO ELECTRIC CO	SPRINGFIELD	ILL
71590	CENTRALAB	MILWAUKEE	WISC
72259	NYTRONICS INC	BERKELEY HTS	NJ
72982	ERIE RESISTOR CORP	ERIE	PA
75915	LITTLEFUSE INC	DES PLAINS	ILL
78488	STACKPOLE CARBON CO-MAGNET DIV	ST MARYS	PA
79089	RADIO CORP OF AMERICA	HARRISON	NJ
80183	SPRAGUE PDTS CO	N ADAMS	MASS
80294	BOURNS LABORATORIS INC	RIVERSIDE	CALIF
80368	SYLVANIA ELECTRIC PDTS INC	NEW YORK	NY
83877	ROTRON MFG CO	WOODSTOCK	NY
91637	DALE PRODUCTS INC	COLUMBUS	NEB
98291	SEAELECTRO CORP	MAMARONEK	NY

CHAPTER 7 DIAGRAMS

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*Serial Numbers are Approximate.

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*Serial Numbers are Approximate.

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*Serial Numbers are Approximate.

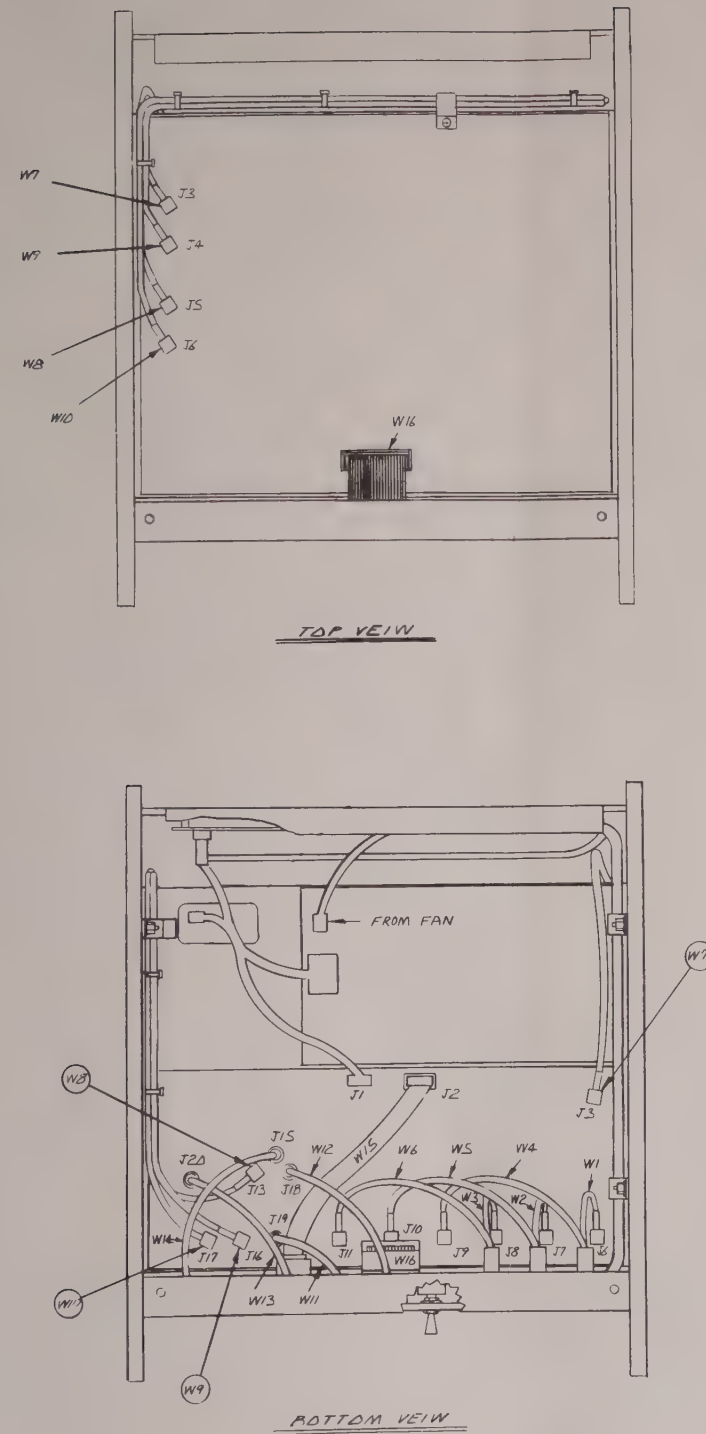


**Figure 7.1. Chassis Assembly Cable
Installation Reference
(Sheet 1 of 3)***

252910B
35G031Z

*APPLIES TO UNITS WITH
SERIAL NUMBERS 10 AND BELOW
(APPROXIMATELY)

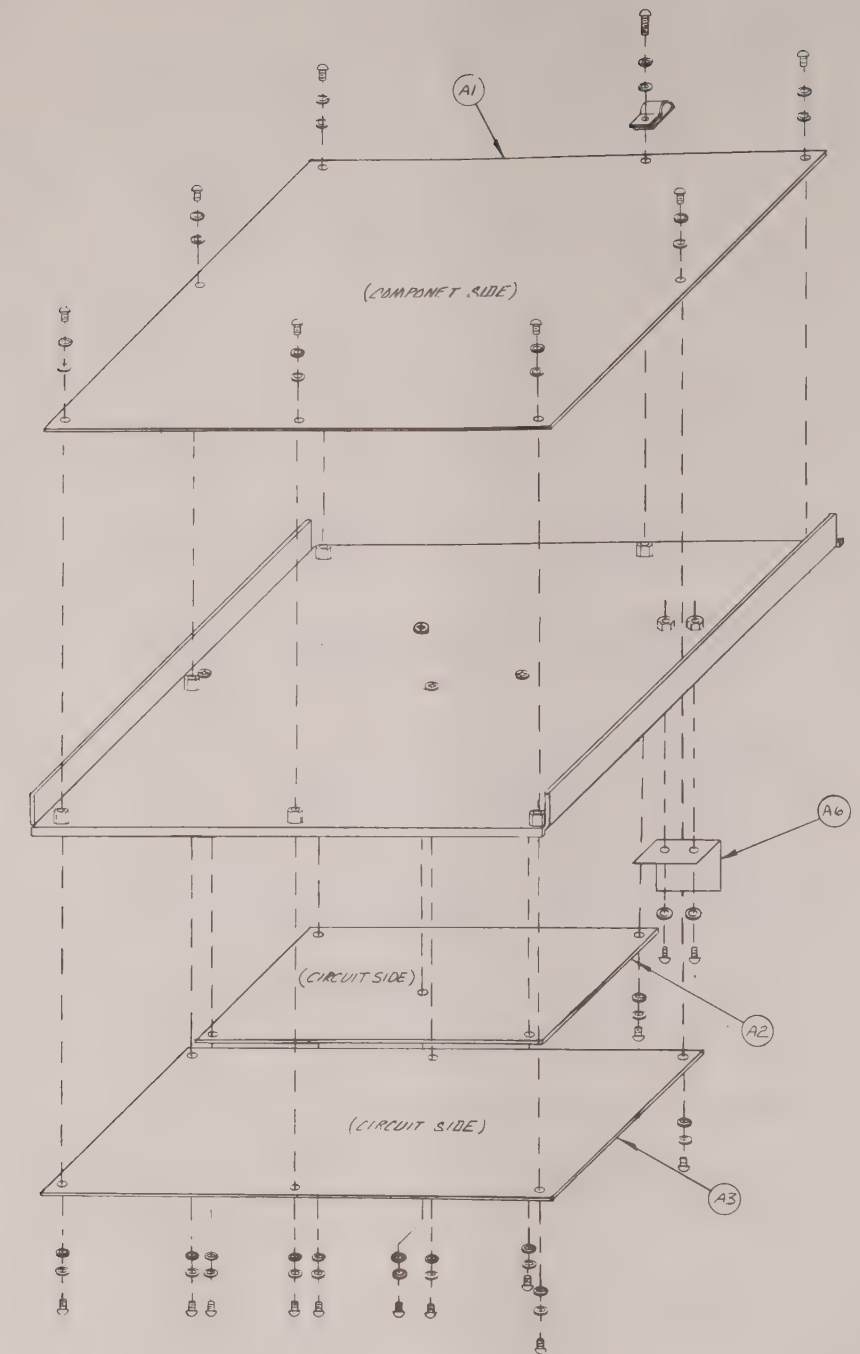
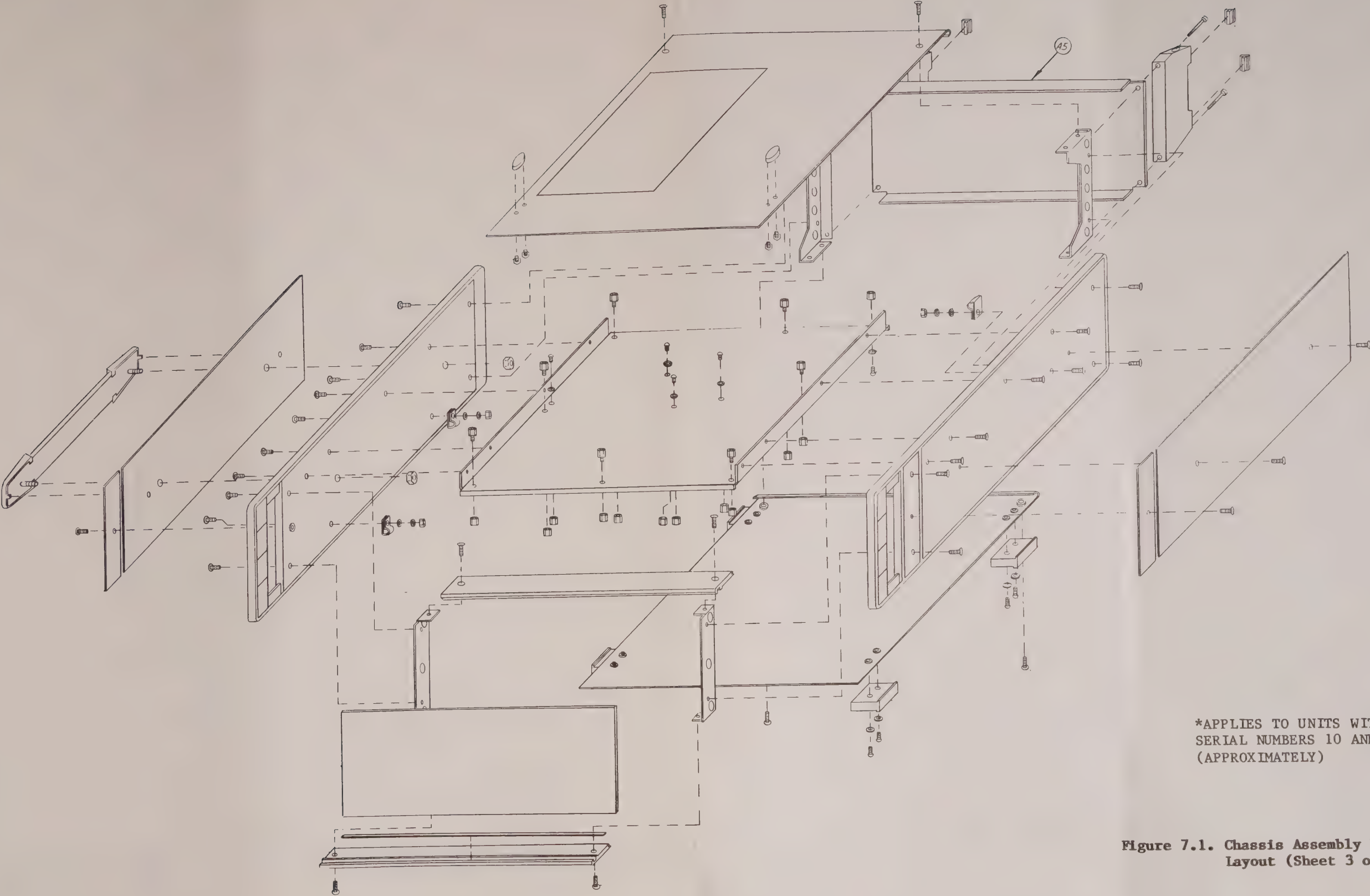


Figure 7.1. Chassis Assembly Printed
Circuit Board (PCB)
Installation Reference
(Sheet 2 of 3)*



*APPLIES TO UNITS WITH
SERIAL NUMBERS 10 AND BELOW
(APPROXIMATELY)

Figure 7.1. Chassis Assembly Mechanical
Layout (Sheet 3 of 3)*

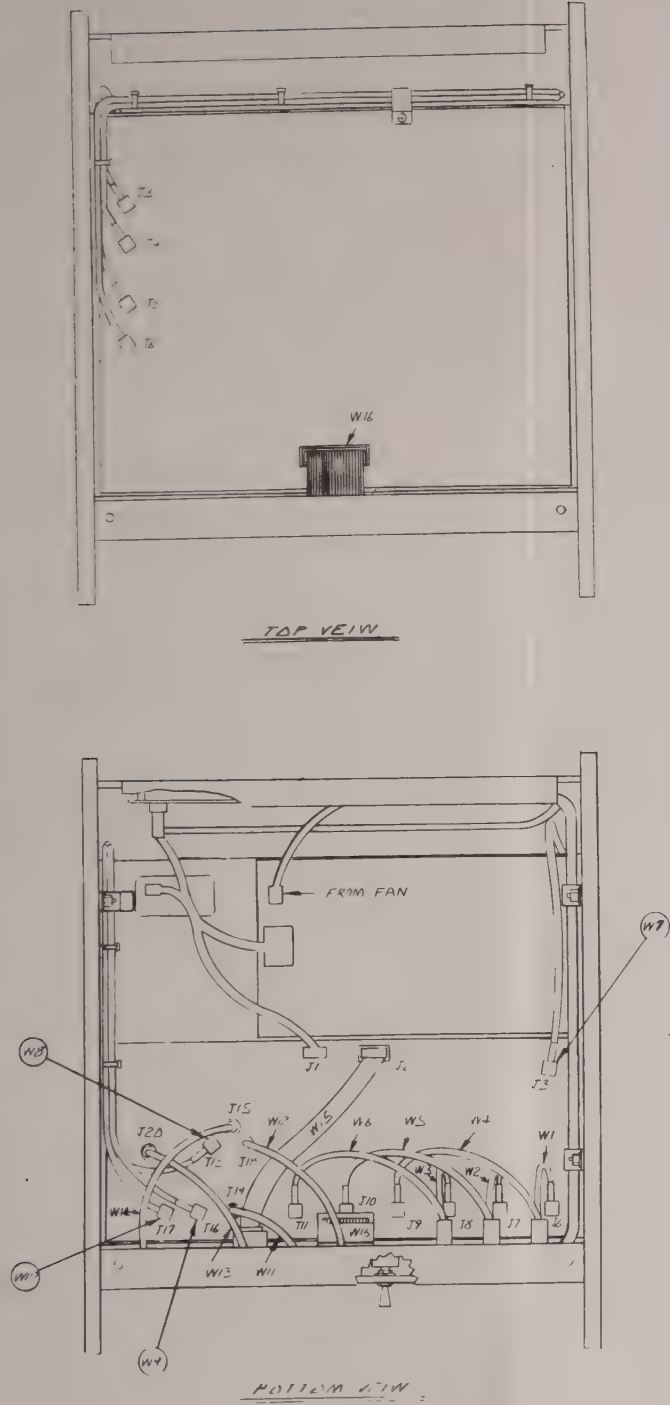


Figure 7.1a. Chassis Assembly Cable
Installation Reference
(Sheet 1 of 3)*

252845
35G031Z

*APPLIES TO UNITS WITH
SERIAL NUMBERS 11 AND ABOVE
(APPROXIMATELY)

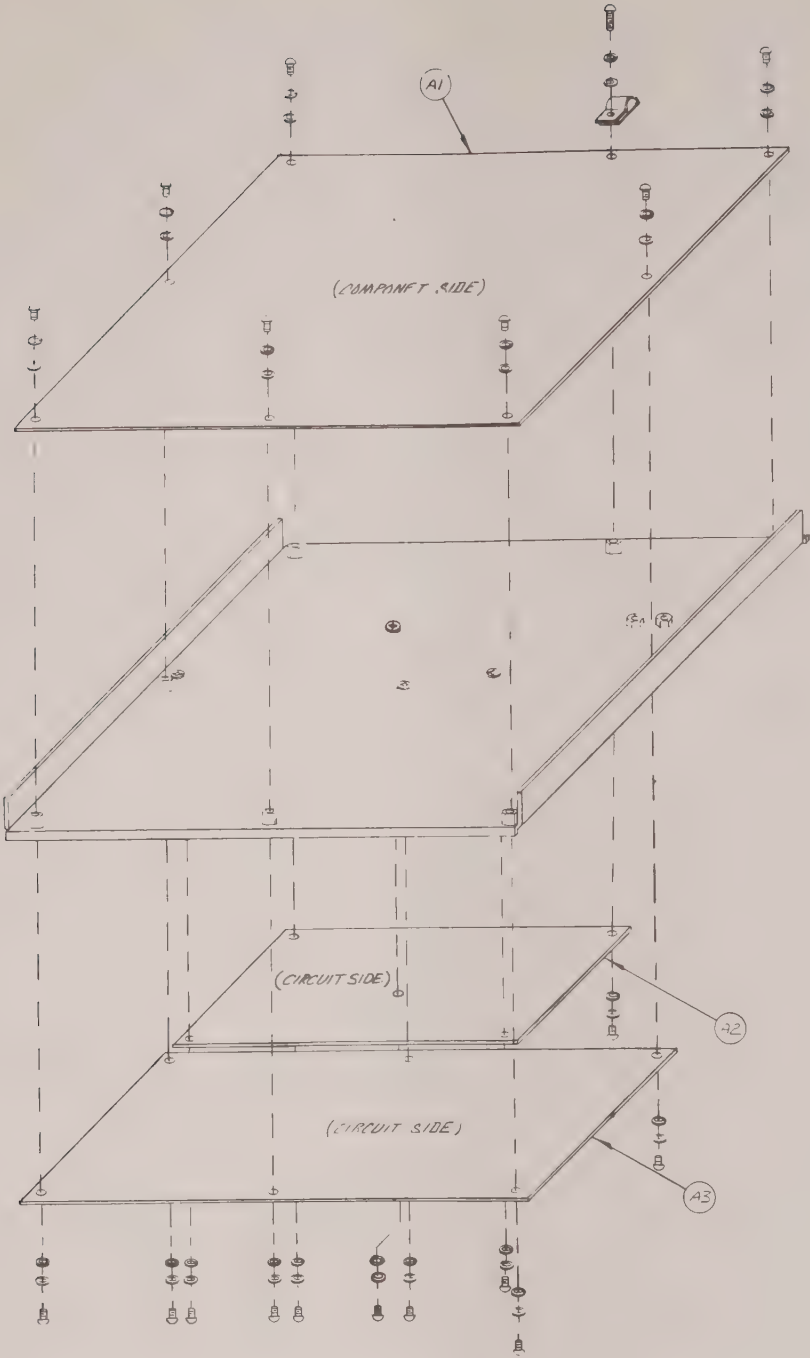
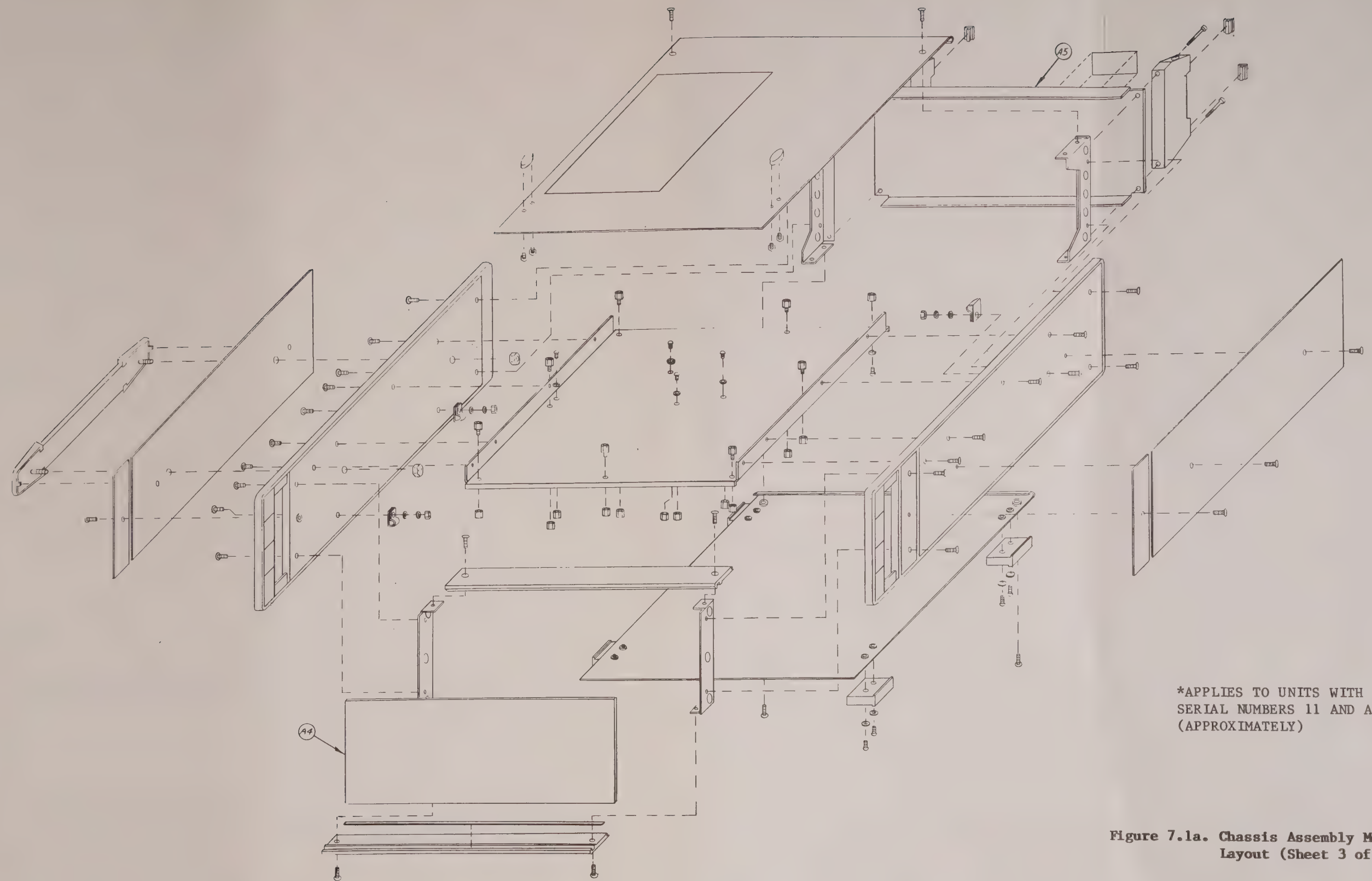
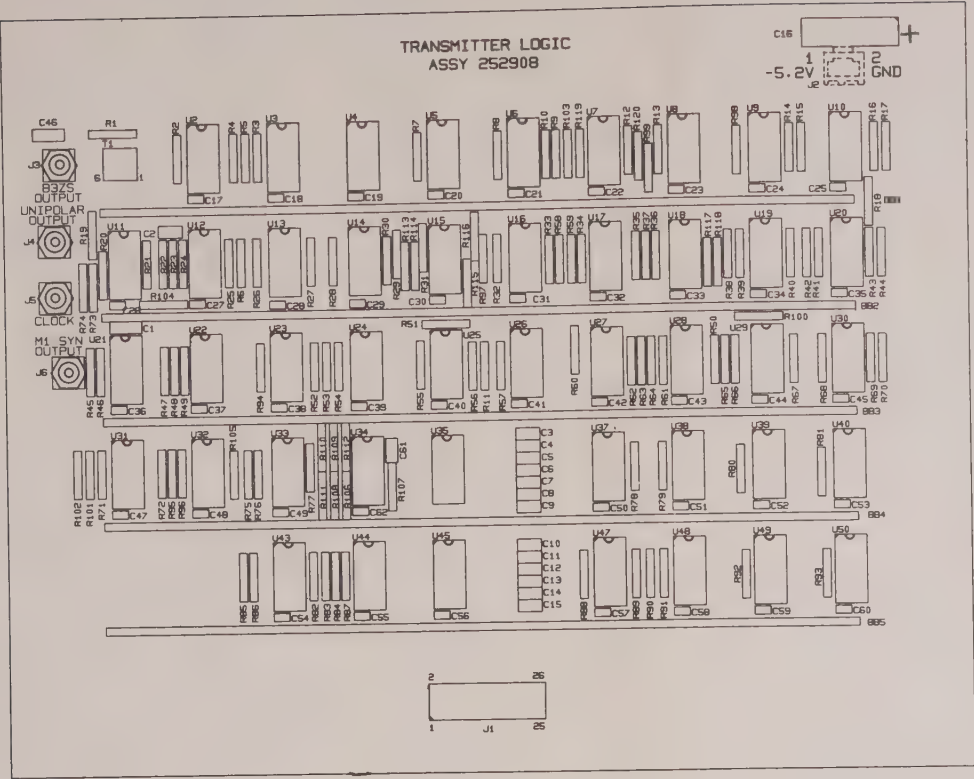


Figure 7.1a. Chassis Assembly Printed
Circuit Board (PCB)
Installation Reference
(Sheet 2 of 3)*



*APPLIES TO UNITS WITH
SERIAL NUMBERS 11 AND ABOVE
(APPROXIMATELY)

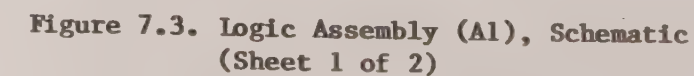
Figure 7.1a. Chassis Assembly Mechanical
Layout (Sheet 3 of 3)*



NOTES:

REFERENCE DESIGNATIONS NOT USED:
U36, U41, U42 AND U46.

Figure 7.2. Logic Assembly (A1), Component Location



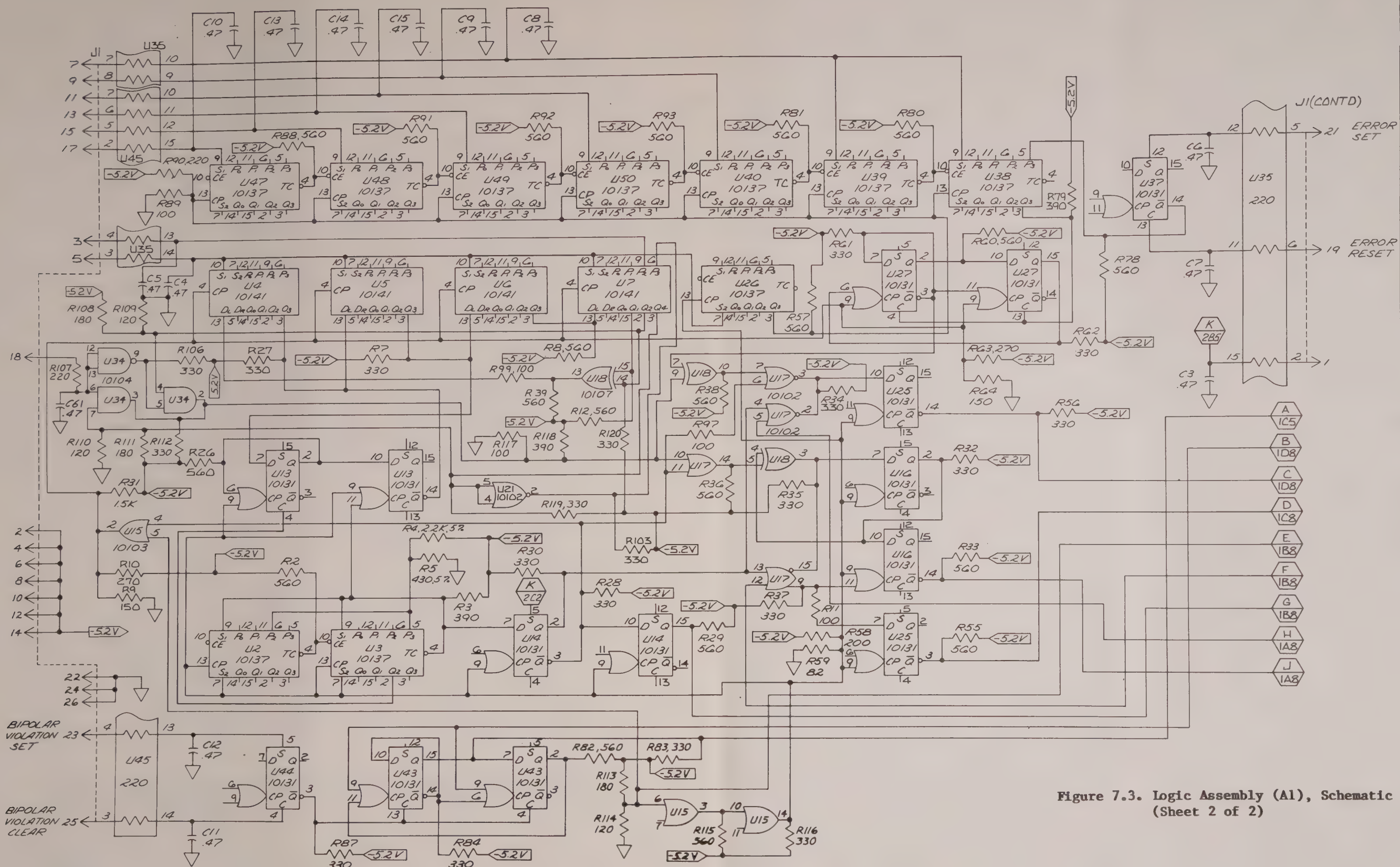
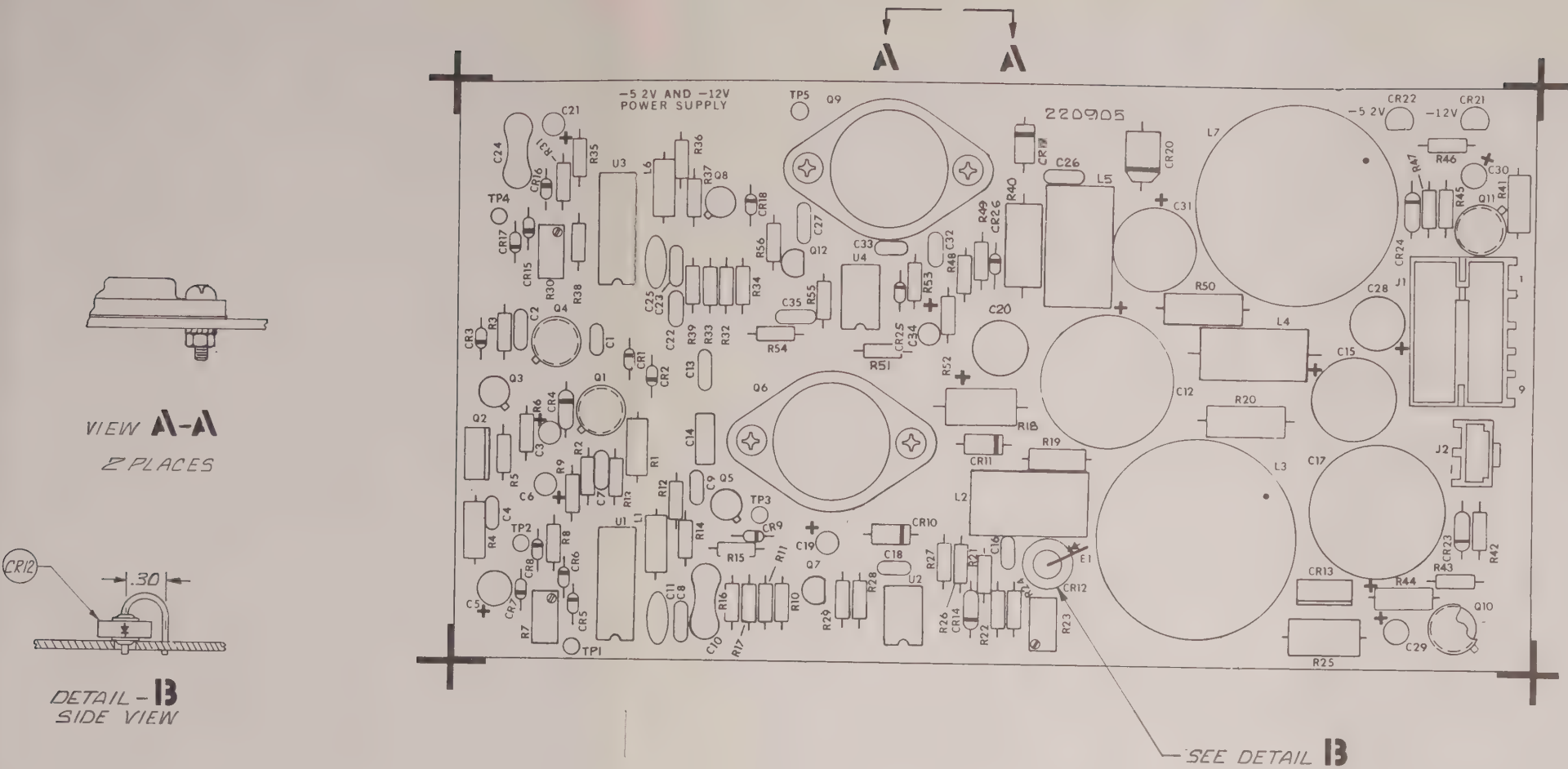


Figure 7.3. Logic Assembly (A1), Schematic (Sheet 2 of 2)



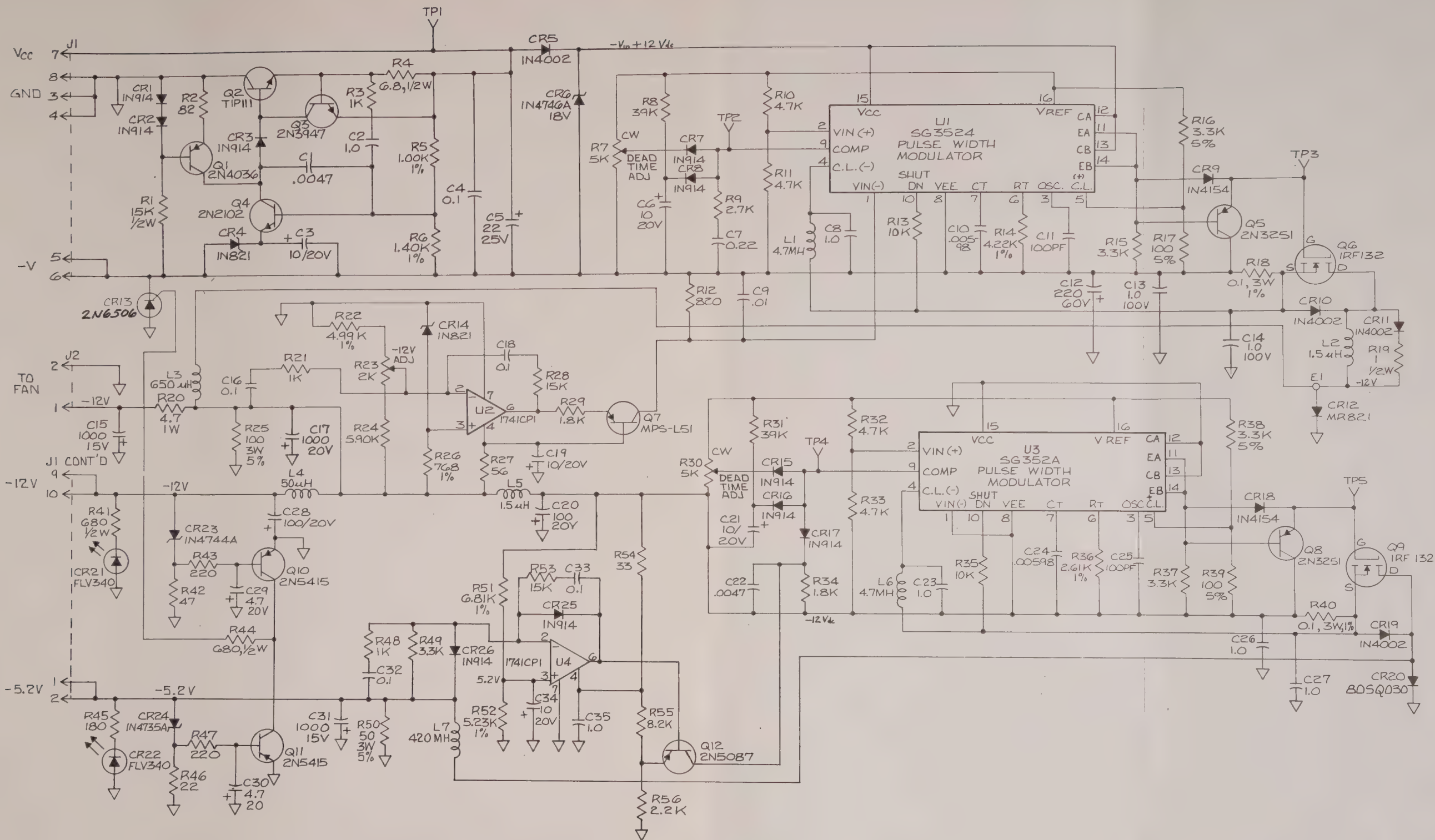
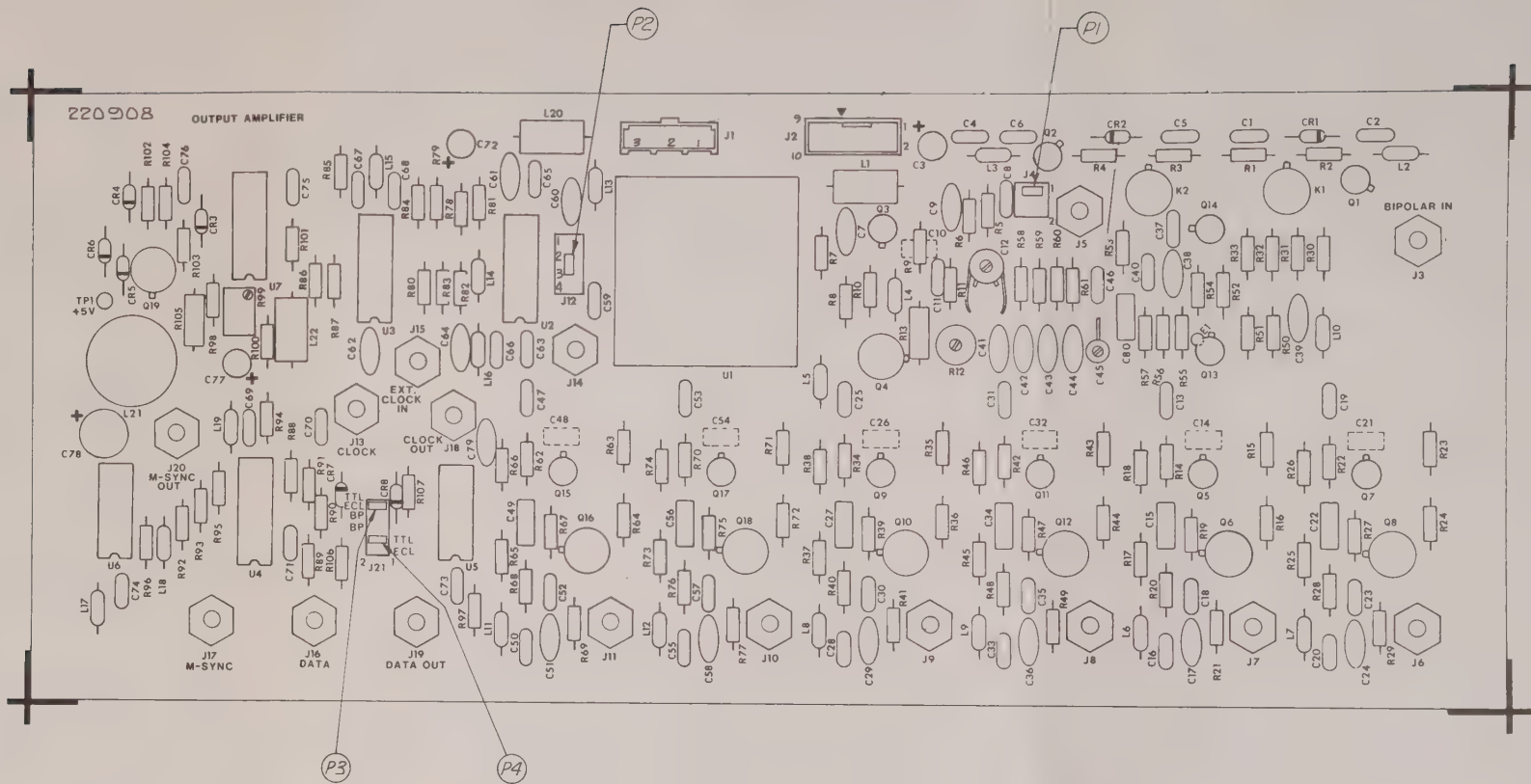
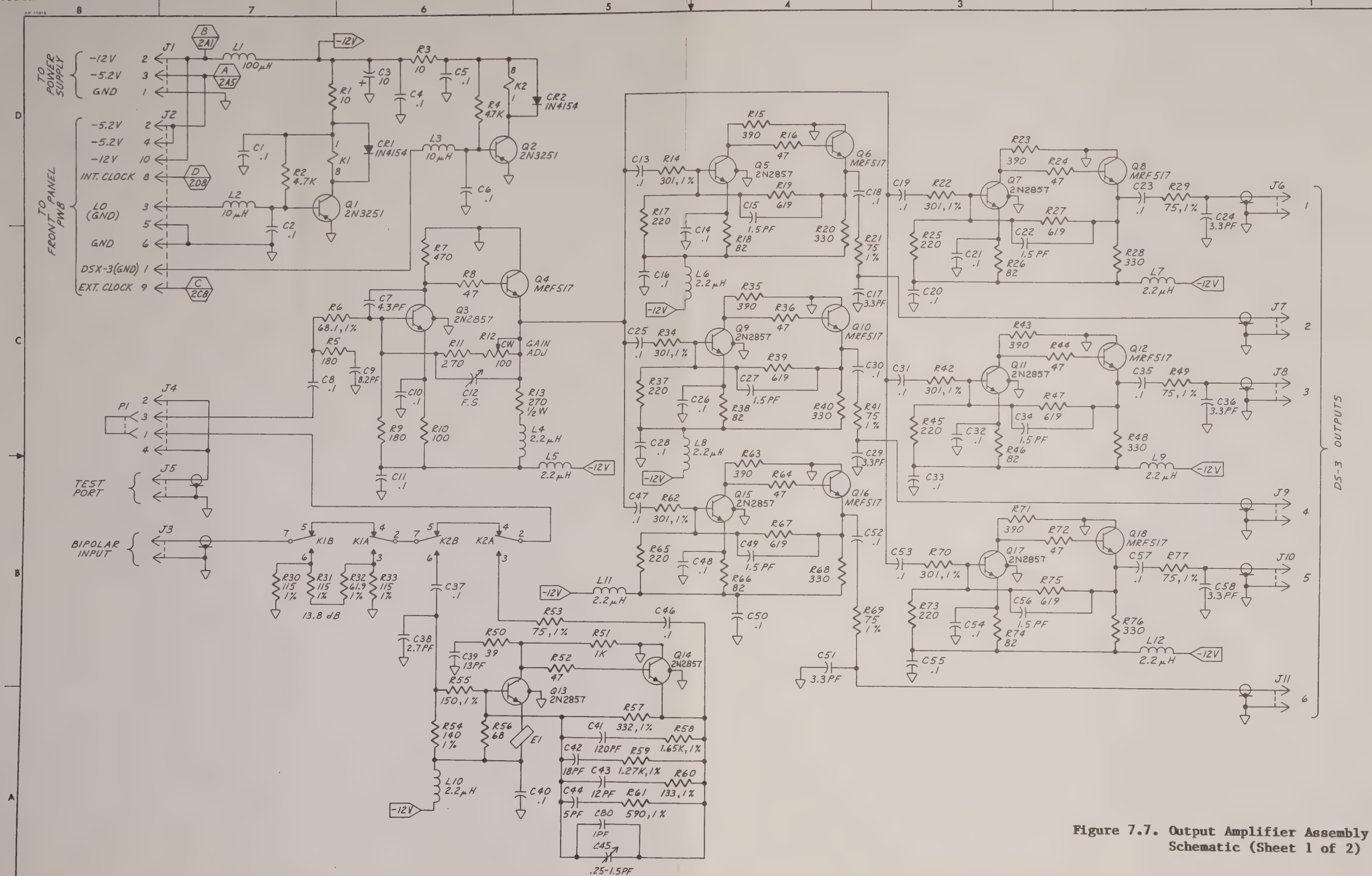


Figure 7.5. -5.2V/-12V Power Supply Assembly (A2), Schematic





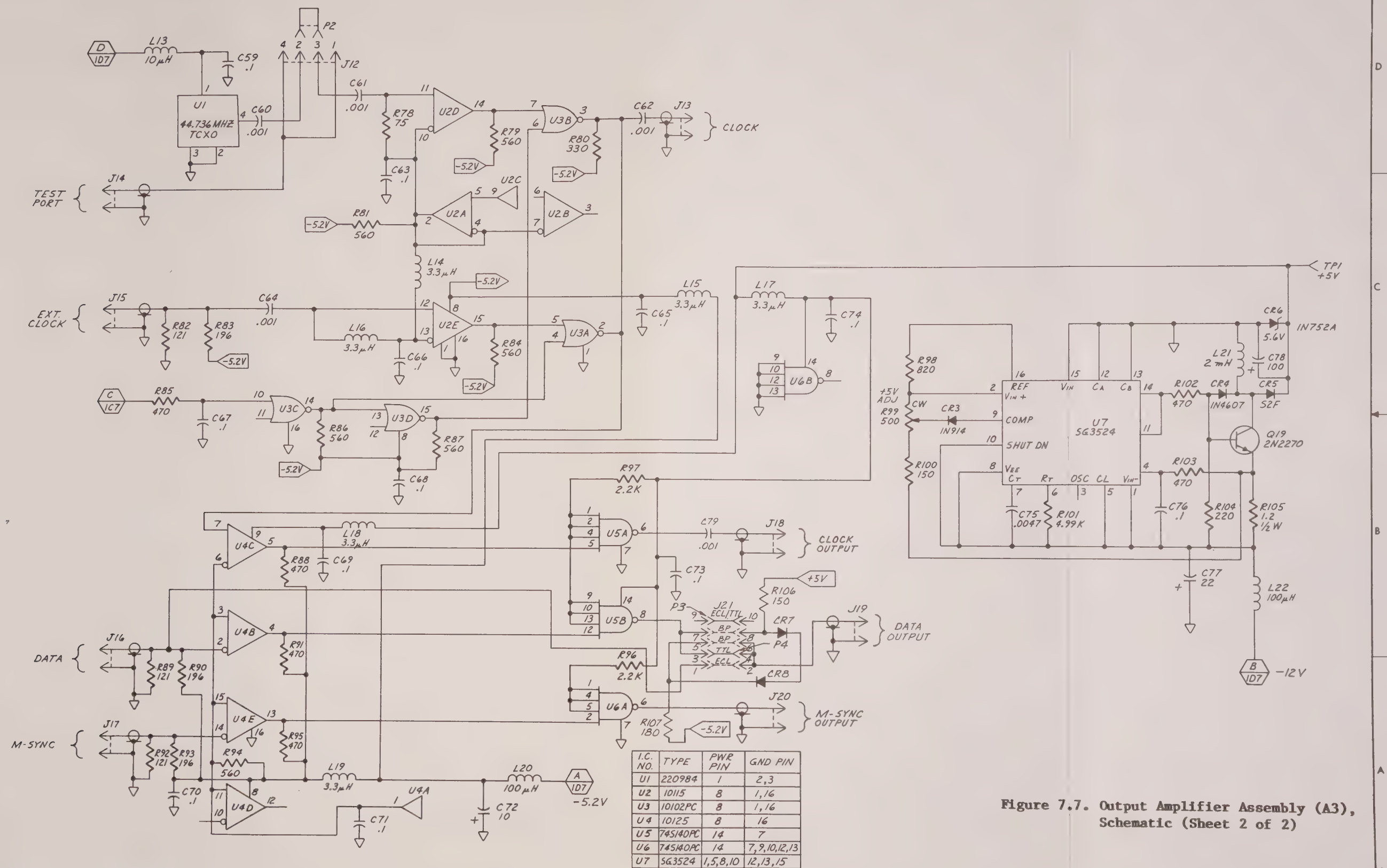


Figure 7.7. Output Amplifier Assembly (A3),
Schematic (Sheet 2 of 2)

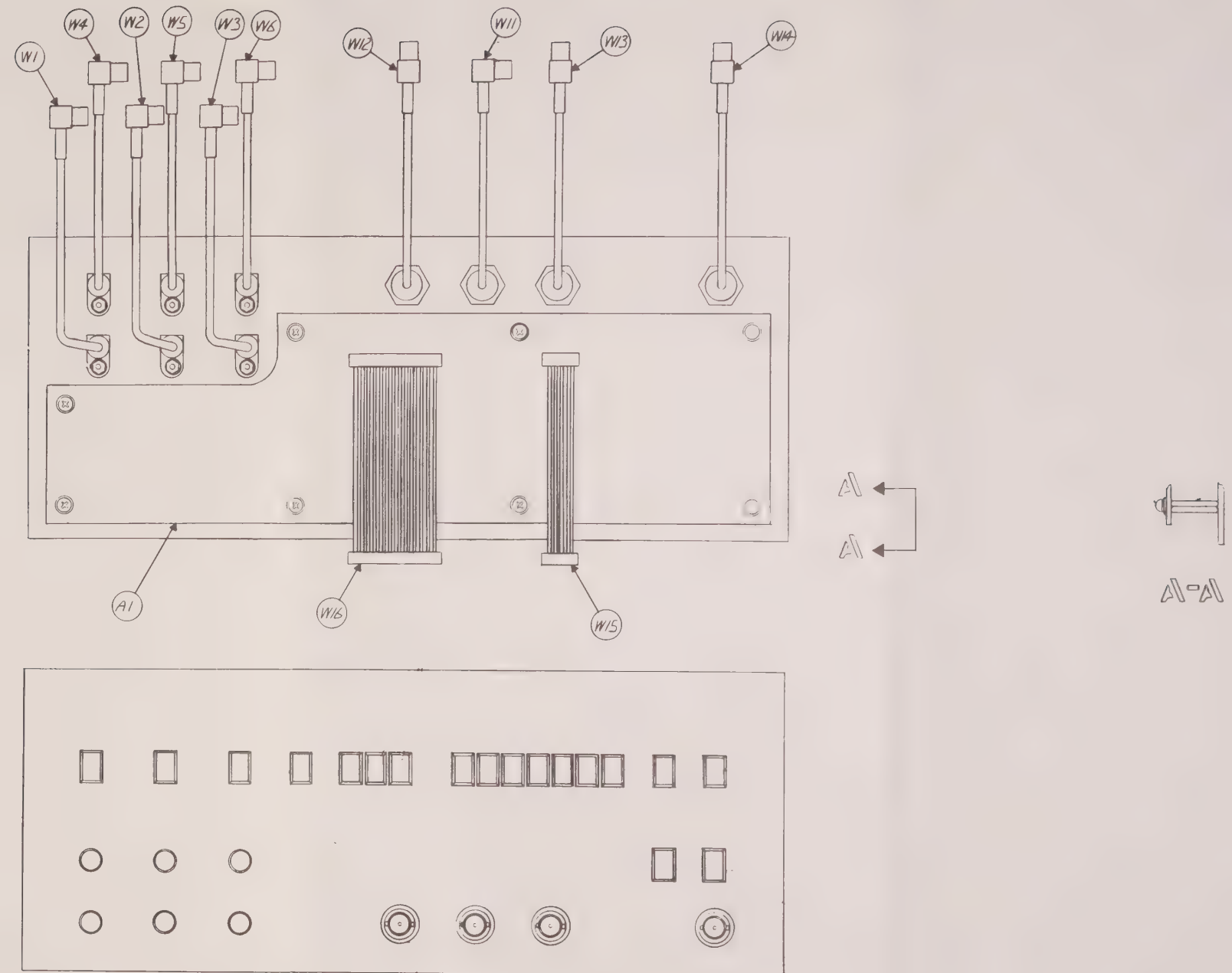


Figure 7.8. Front Panel Assembly (A4),
Cable Installation Reference

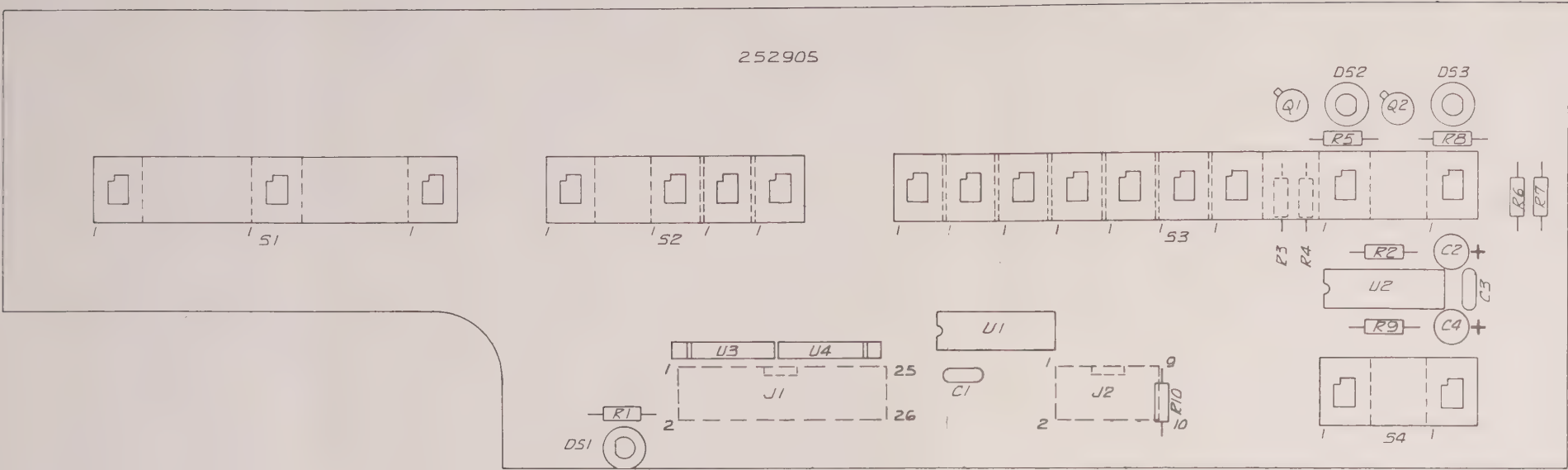


Figure 7.9. Front Panel Assembly (A4A1),
Component Location

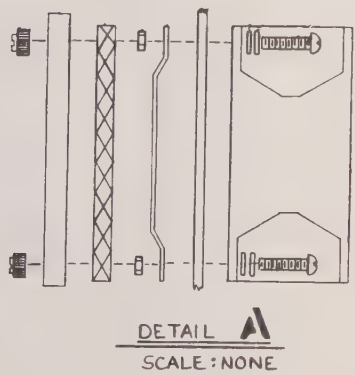
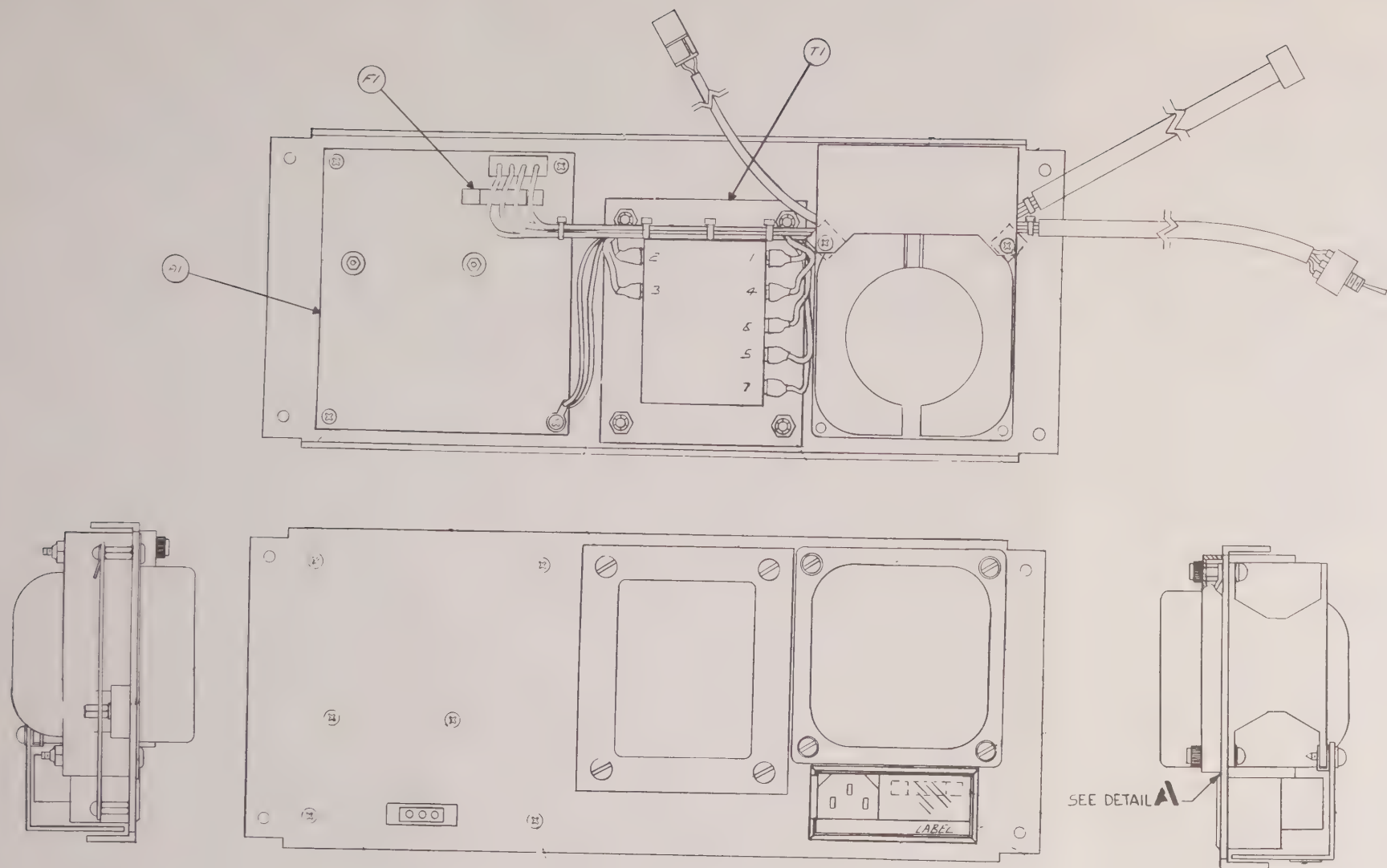


Figure 7.11. Rear Panel Assembly (A5),
Component Location and Cable
Installation Reference*

220950C
35G031Z

*APPLIES TO UNITS WITH
SERIAL NUMBERS 10 AND BELOW
(APPROXIMATELY)

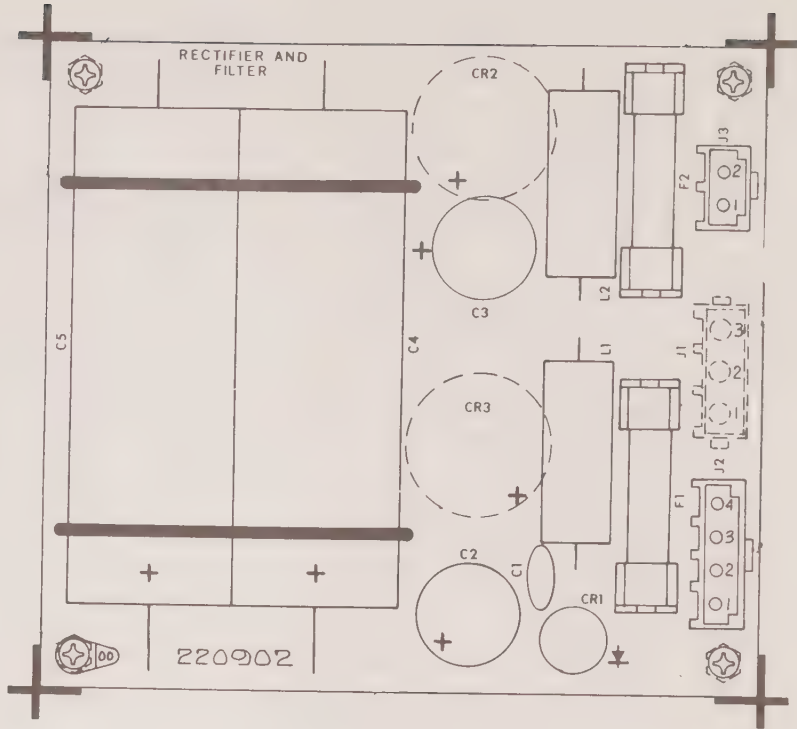
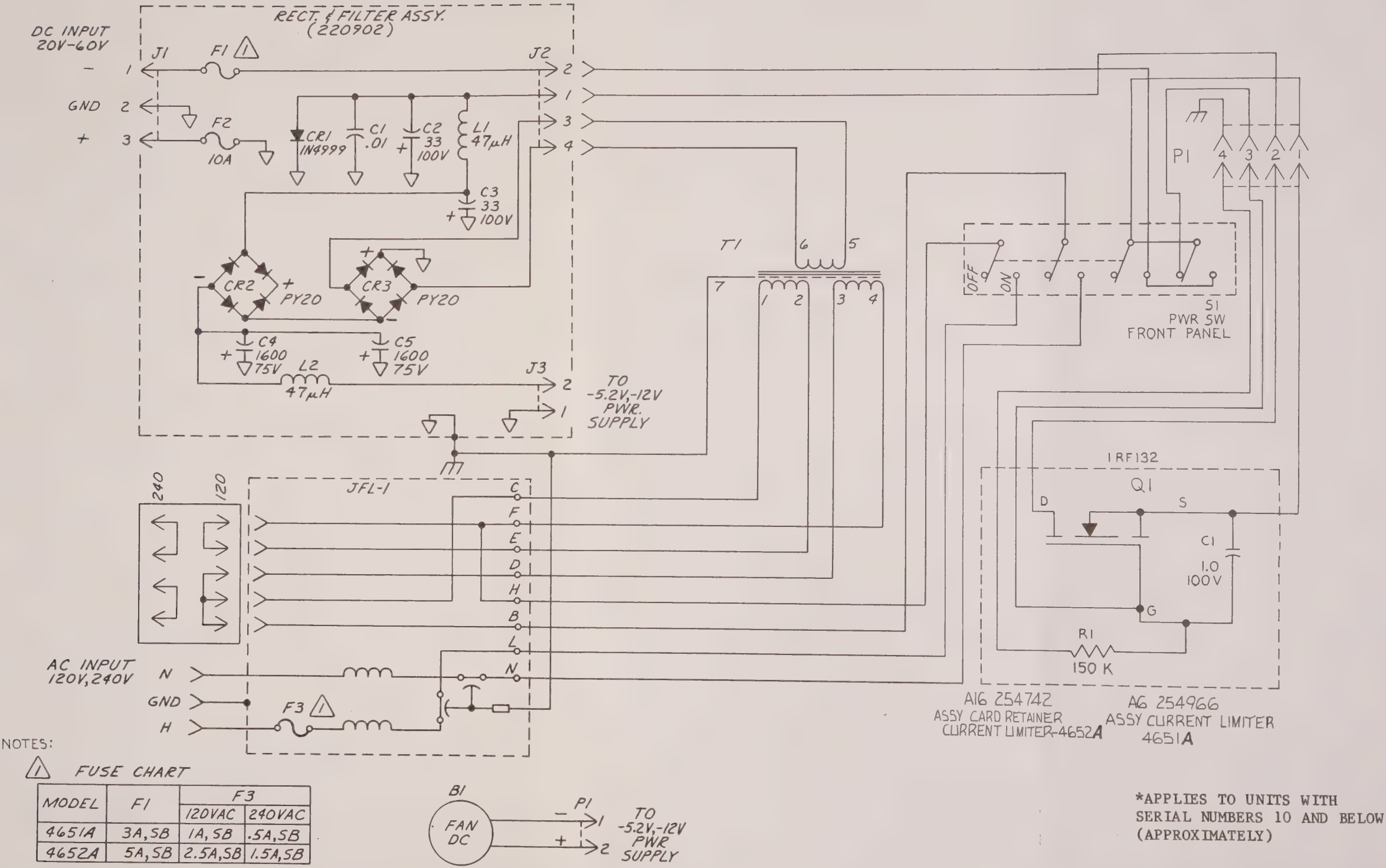


Figure 7.12. Rear Panel Rectifier and
Filter Assembly (A5A1),
Component Location*

220902B



*APPLIES TO UNITS WITH
SERIAL NUMBERS 10 AND BELOW
(APPROXIMATELY)

Figure 7.13. Rear Panel Rectifier and
Filter Assembly (A5A1),
Schematic*

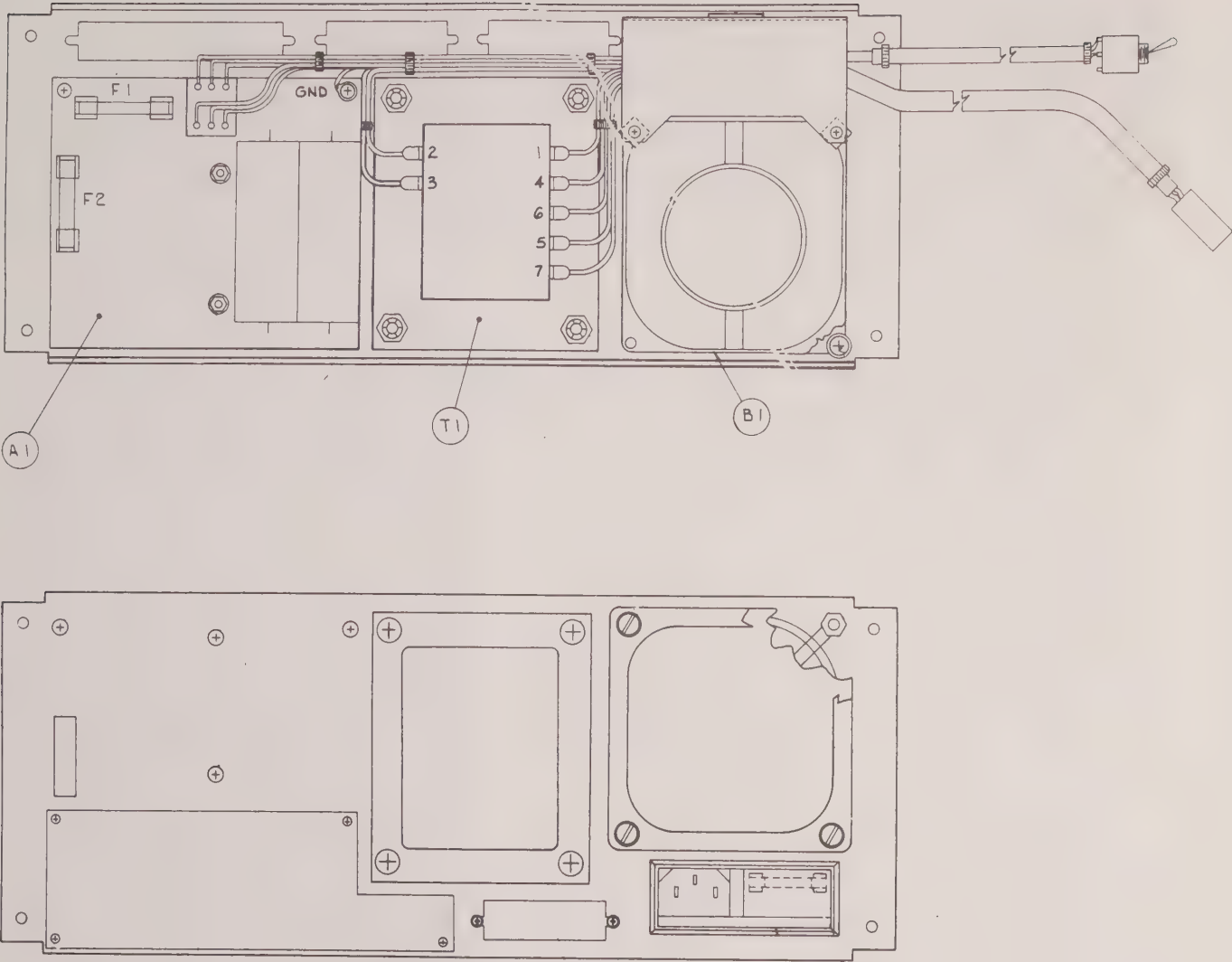


Figure 7.11a. Rear Panel Assembly (A5),
Component Location and Cable
Installation Reference*

252842
35G0312

*APPLIES TO UNITS WITH
SERIAL NUMBERS 11 AND ABOVE
(APPROXIMATELY)

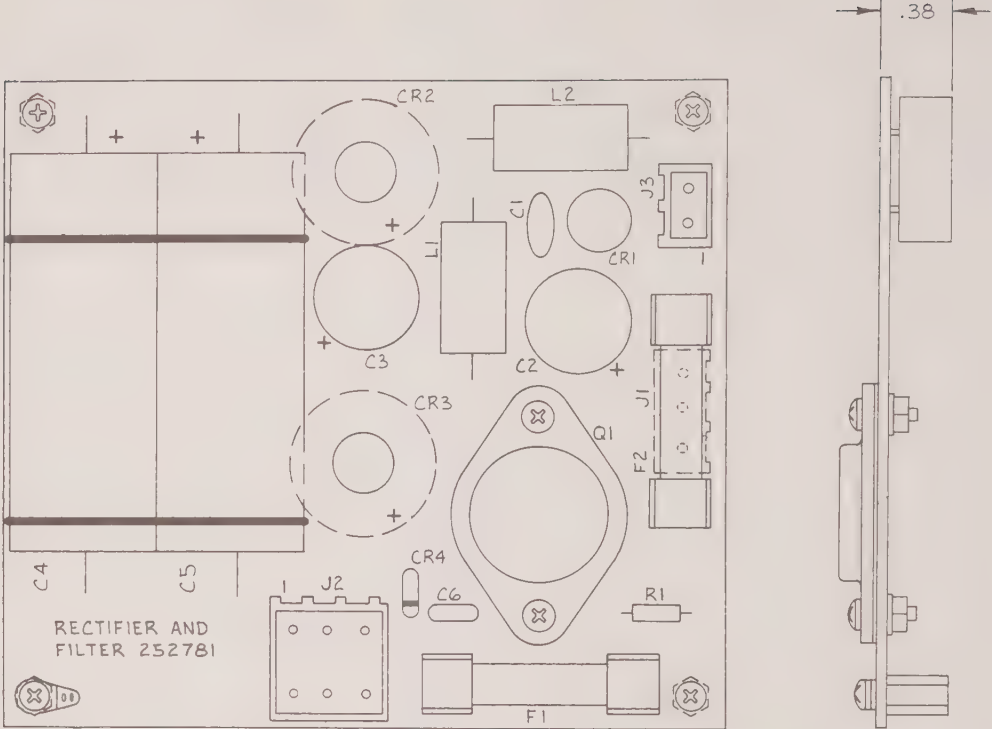
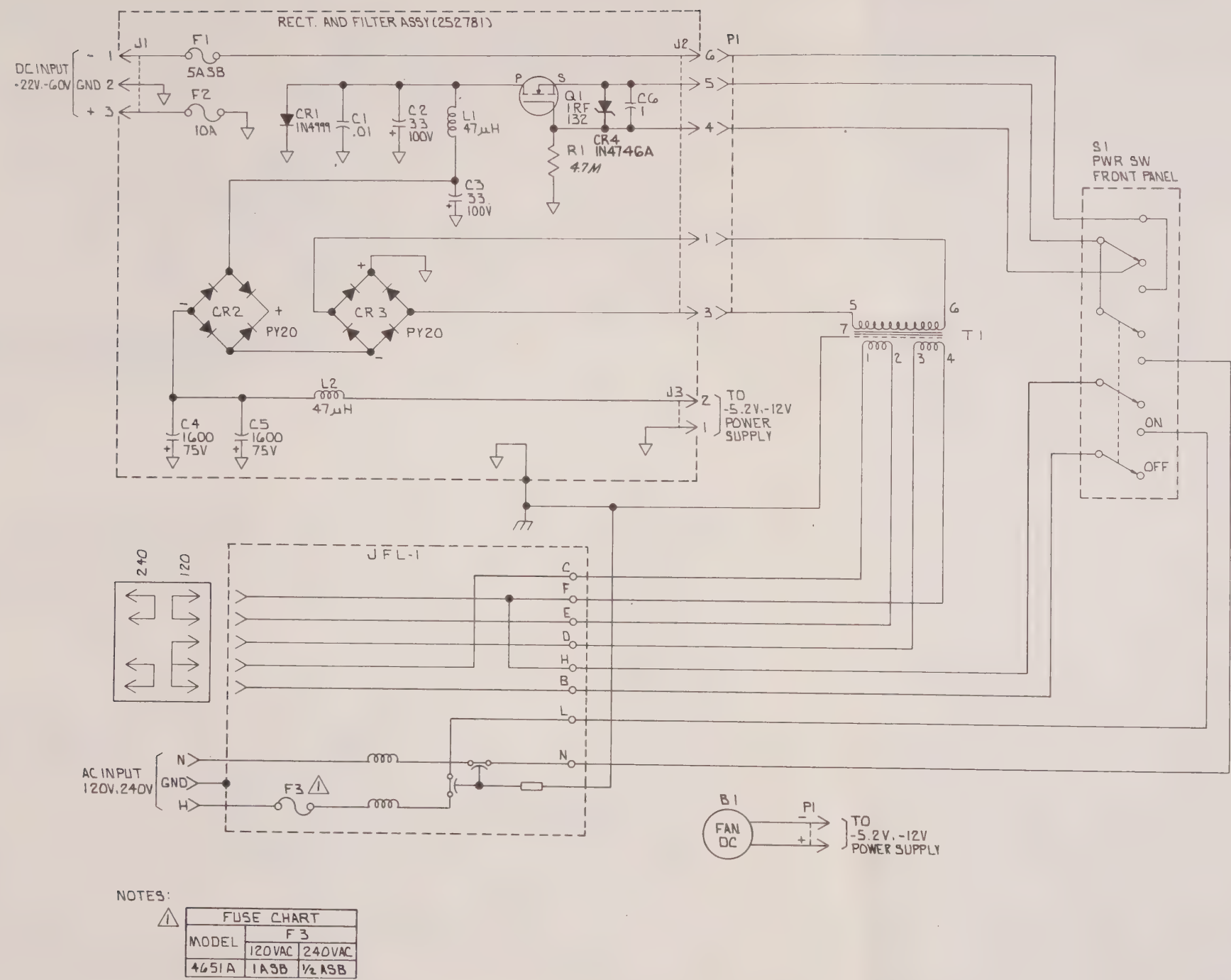


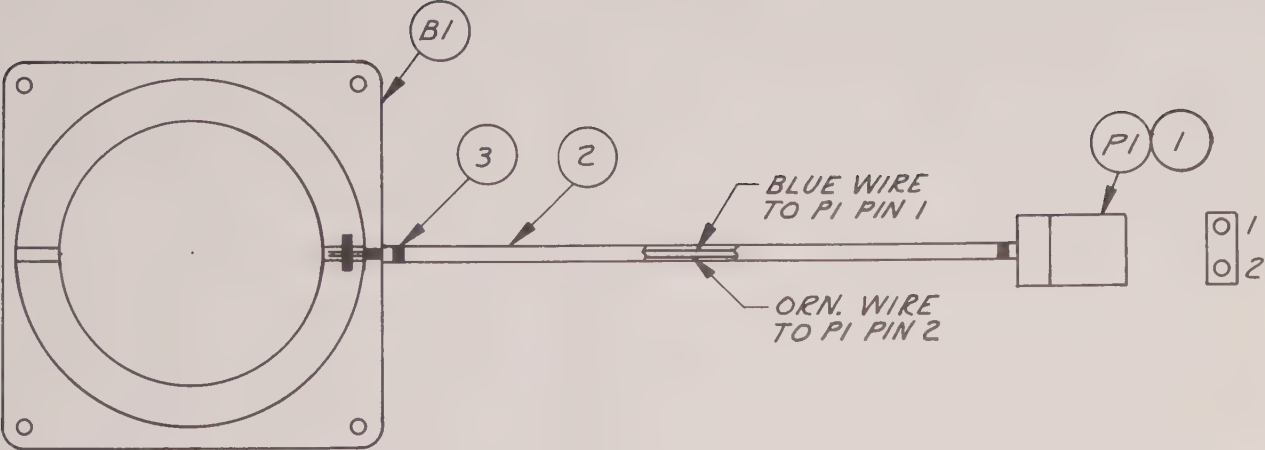
Figure 7.12a. Rear Panel Rectifier and
Filter Assembly (A5A1),
Component Location*

252781



*APPLIES TO UNITS WITH
SERIAL NUMBERS 11 AND ABOVE
(APPROXIMATELY)

Figure 7.13a. Rear Panel Rectifier and
Filter Assembly (A5A1),
Schematic



B1	1	89647	FAN	9.5-14VDC	
PI	1	87358	CONN. HOUSING, RECT.	2 CKT., BLUE	1-480-720-6
3	2	73045	CABLE TIE	4 IN. LONG	
2	.9FT	73212	TUBING, VINYL	8 AWG.	
1	2	86010	CONN. CONTACT, FEM.		60617-5
ITEM OR FIND NO.	QTY REQD	S. A. STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO

PARTS LIST

Figure 7.14. Rear Panel Fan Assembly (A5B1)

220951

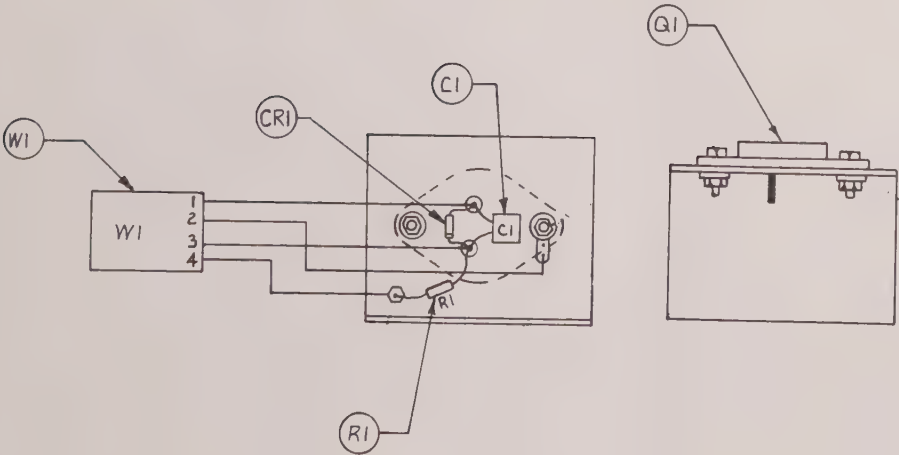


Figure 7.15. Current Limiter Assembly (A6), Component Location (Applies to Units With Serial No. 14* and Below)

254965A
35G031A

*SERIAL NUMBERS ARE APPROXIMATE
1 A6 IS NOT USED IN SERIAL NUMBER
57* AND ABOVE

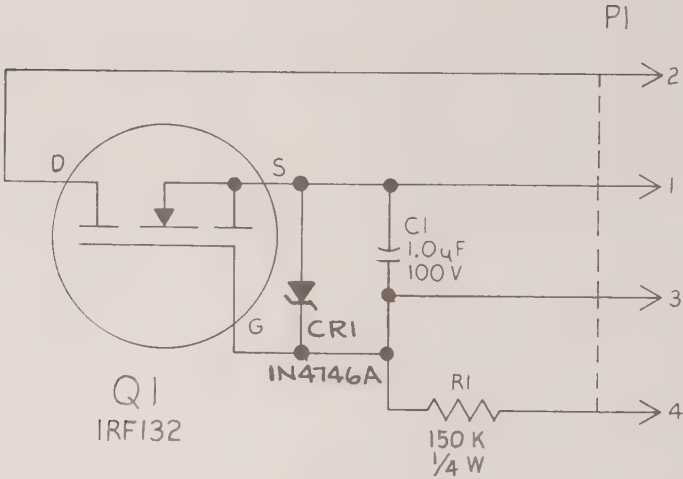


Figure 7.16. Current Limiter Assembly (A6), Schematic (Applies to Units With Serial No. 14* and Below)

254743A

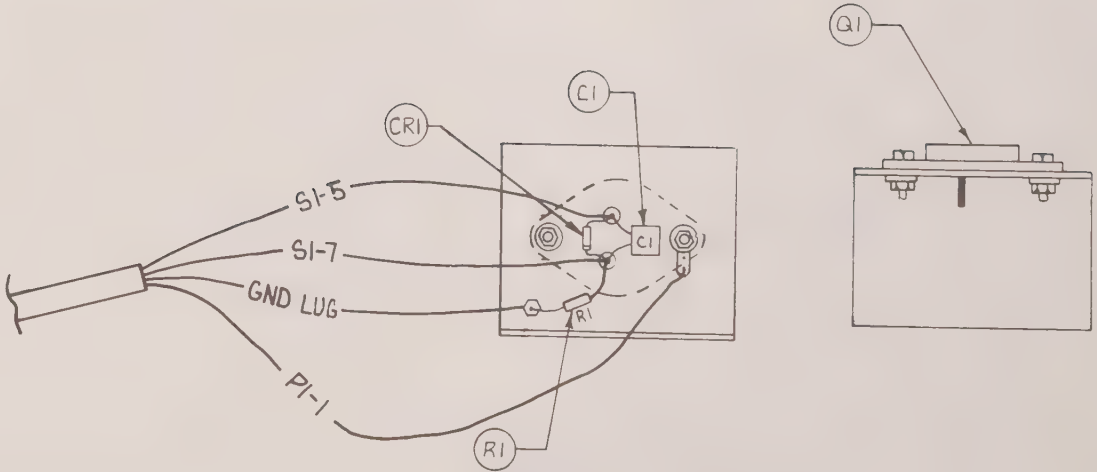


Figure 7.15a. Current Limiter Assembly (A6), Component Location (Applies to Units With Serial No. 15* and Above)

254965C

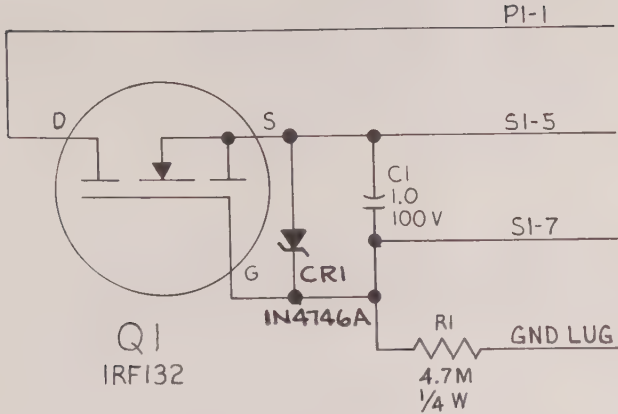


Figure 7.16a. Current Limiter Assembly (A6), Schematic

254743C

*APPLIES TO UNITS WITH SERIAL NUMBERS 15 AND ABOVE (APPROXIMATELY)
A6 IS NOT USED IN SERIAL NUMBER 57 AND ABOVE (APPROXIMATELY).

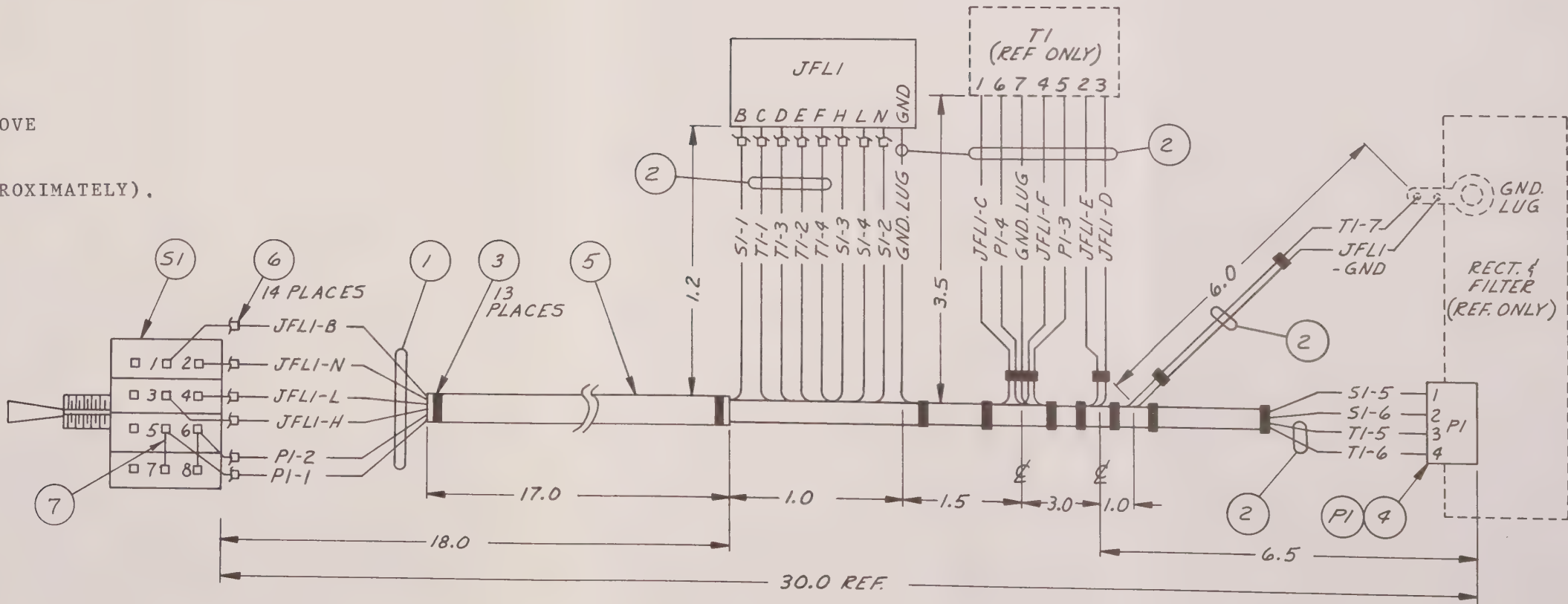
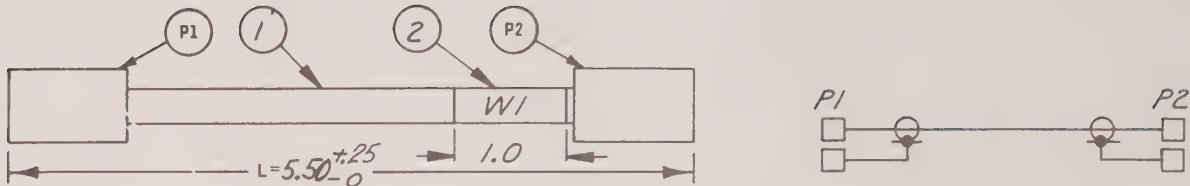
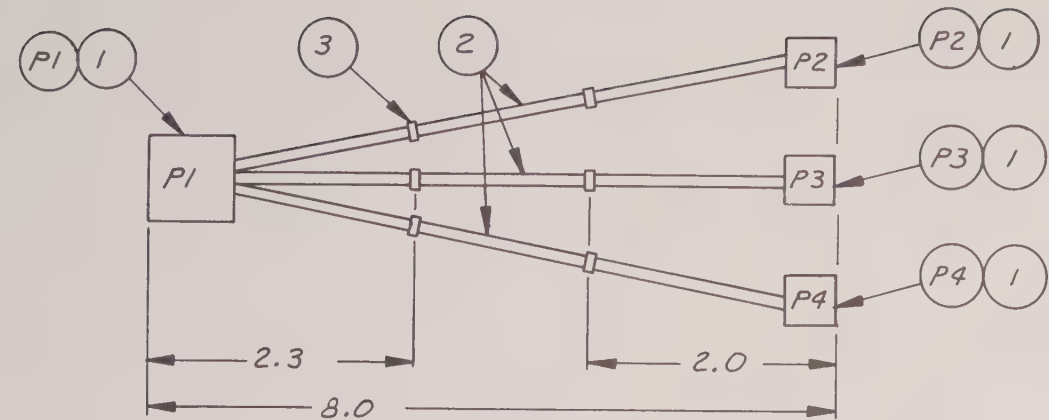


Figure 7.17. Power Wiring Harness, External Power Sources

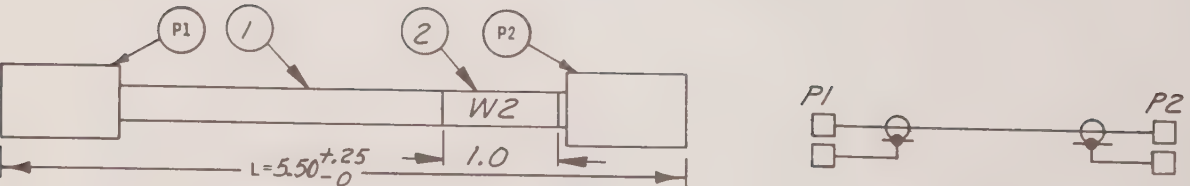
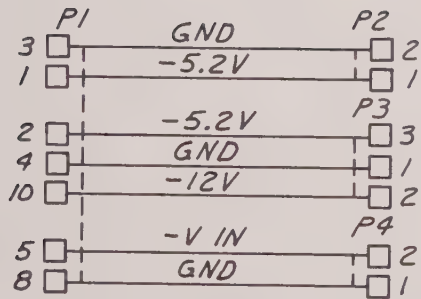
ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO
JFLI	1	83759	CONN., AC, 3 COND.	MALE W/FUSE BLK & FILT.	6J4
PI	1	87462	CONN. HOUSING, RECT.	POS. LOCK, 4 CKT.	1-480722-0
SI	1	170261	SWITCH, 3 PDT		
7	2FT	73318	WIRE, BUS	22 AWG	
6	.6FT	75929	TUBING, HEAT SHRINK	.125 ID	
5	1.5FT	73208	TUBING, VINYL	9 AWG	
4	4	86010	CONN. CONTACT, FEM.		60617-5
3	13	73045	CABLE TIE	9 IN. LONG	
2	7.2FT	73356	WIRE, STRD., WHT.	18 AWG	
1	11FT	73374	WIRE, STRD., WHT.	20 AWG	
PARTS LIST					



P2	1	84938	CONNECTOR, COAX	75Ω SMB	51-128-9511	
P1	1	83419	CONNECTOR, COAX	MIN. PNL. JACK	J12-4	
2	.1FT	85219	TUBING, HEAT SHRINK		RT-876 WHT 1/4 DIA	
1	.5FT	83156	CABLE, COAX		8218	
ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
PARTS LIST						

Figure 7.19. DS3 Output Cable Assembly (W1)

220958



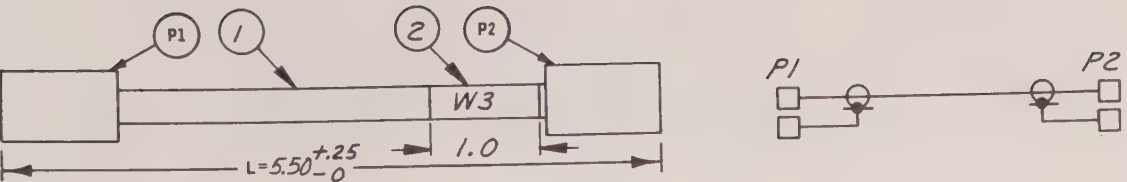
P2	1	84938	CONNECTOR, COAX	75Ω SMB	51-128-9511	
P1	1	83419	CONNECTOR, COAX	MIN. PNL. JACK	J12-4	
2	.1FT	85219	TUBING, HEAT SHRINK		RT-876 WHT 1/4 DIA	
1	.5FT	83156	CABLE, COAX	75Ω	8218	
ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
PARTS LIST						

Figure 7.20. DS3 Output Cable Assembly (W2)

220959

Figure 7.18. Power Wiring Harness, Internal Power Sources

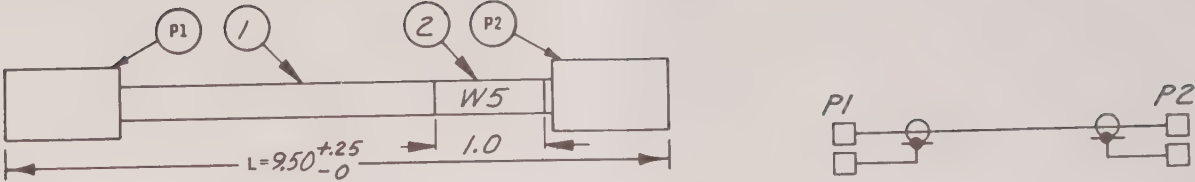
220955



P2	1	84938	CONNECTOR, COAX	75Ω SMB	51-128-9511	
P1	1	83419	CONNECTOR, COAX	MIN. PNL. JACK	J12-4	
2	.1FT	85219	TUBING, HEAT SHRINK		RT-876 WHT 1/4 DIA	
1	.5FT	83156	CABLE, COAX	75Ω	8218	
ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
PARTS LIST						

Figure 7.21. DS3 Output Cable Assembly (W3)

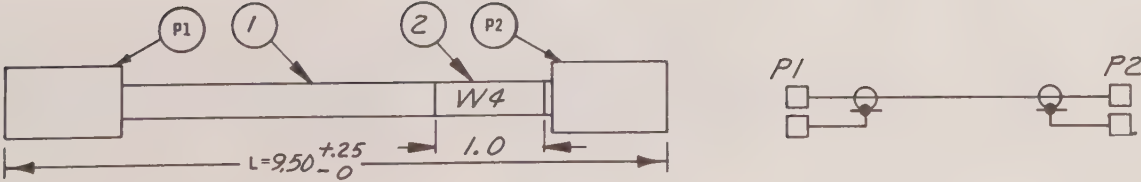
220960



P2	1	84938	CONNECTOR, COAX	75Ω SMB	51-128-9511	
P1	1	83419	CONNECTOR, COAX	MIN. PNL. JACK	J12-4	
2	.1FT	85219	TUBING, HEAT SHRINK		RT-876 WHT 1/4 DIA	
1	.9FT	83156	CABLE, COAX	75Ω	8218	
ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
PARTS LIST						

Figure 7.23. DS3 Output Cable Assembly (W5)

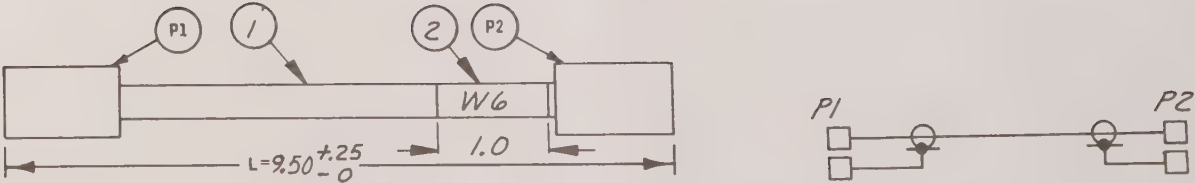
220962



P2	1	84938	CONNECTOR, COAX	75Ω SMB	51-128-9511	
P1	1	83419	CONNECTOR, COAX	MIN. PNL. JACK	J12-4	
2	.1FT	85219	TUBING, HEAT SHRINK		RT-876 WHT 1/4 DIA	
1	.9FT	83156	CABLE, COAX	75Ω	8218	
ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
PARTS LIST						

Figure 7.22. DS3 Output Cable Assembly (W4)

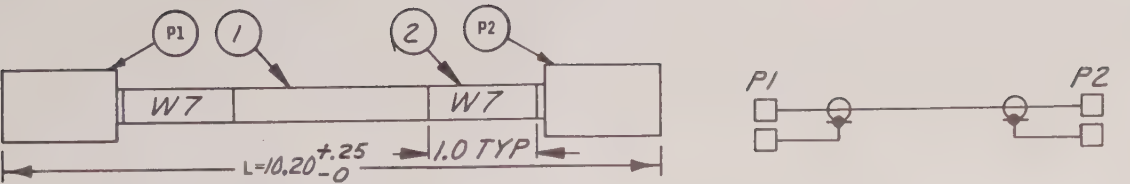
220961



P2	1	84938	CONNECTOR, COAX	75Ω SMB	51-128-9511	
P1	1	83419	CONNECTOR, COAX	MIN. PNL. JACK	J12-4	
2	.1FT	85219	TUBING, HEAT SHRINK		RT-876 WHT 1/4 DIA	
1	.9FT	83156	CABLE, COAX	75Ω	8218	
ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
PARTS LIST						

Figure 7.24. DS3 Output Cable Assembly (W6)

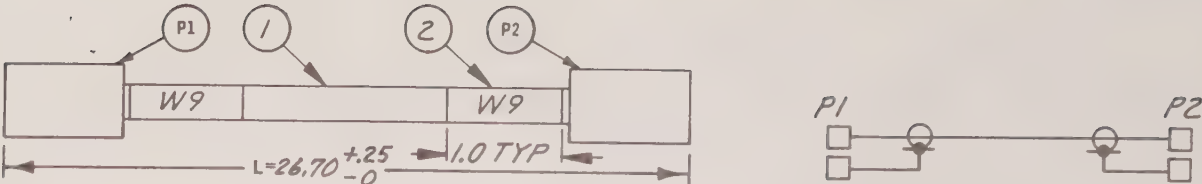
220963



P2	1	84938	CONNECTOR, COAX	75Ω SMB	51-128-9511	
P1	1	84938	CONNECTOR, COAX	75Ω SMB	51-128-9511	
2	.2FT	85219	TUBING, HEAT SHRINK		RT-876 WHT 1/4 DIA	
1	.9FT	83156	CABLE, COAX	75Ω	8218	
ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
PARTS LIST						

Figure 7.25. ECL Interface Cable Assembly (W7)

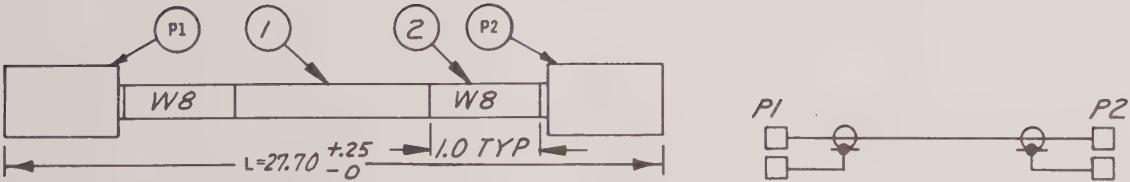
220964



P2	1	84938	CONNECTOR, COAX	75Ω SMB	51-128-9511	
P1	1	84938	CONNECTOR, COAX	75Ω SMB	51-128-9511	
2	.2FT	85219	TUBING, HEAT SHRINK		RT-876 WHT 1/4 DIA	
1	2.3FT	83156	CABLE, COAX	75Ω	8218	
ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
PARTS LIST						

Figure 7.27. ECL Interface Cable Assembly (W9)

220966

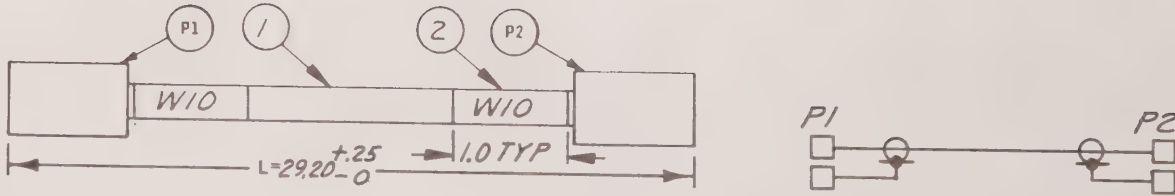


P2	1	84938	CONNECTOR, COAX	75Ω SMB	51-128-9511	
P1	1	84938	CONNECTOR, COAX	75Ω SMB	51-128-9511	
2	.2FT	85219	TUBING, HEAT SHRINK		RT-876 WHT 1/4 DIA	
1	2.4FT	83156	CABLE, COAX	75Ω	8218	
ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
PARTS LIST						

Figure 7.26. ECL Interface Cable Assembly (W8)

220965

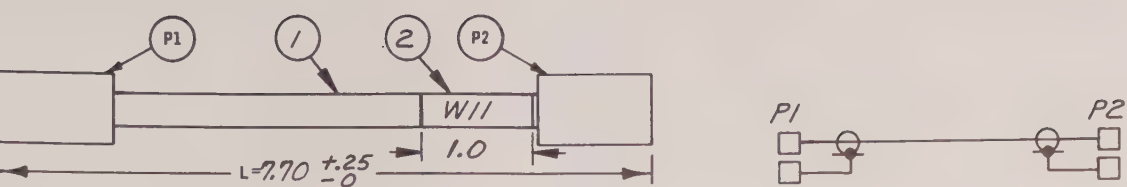
35G031Z



P2	1	84938	CONNECTOR, COAX	75Ω SMB	51-128-9511	
P1	1	84938	CONNECTOR, COAX	75Ω SMB	51-128-9511	
2	.2FT	85219	TUBING, HEAT SHRINK		RT-876 WHT 1/4 DIA	
1	2.5FT	83156	CABLE, COAX	75Ω	8218	
ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
PARTS LIST						

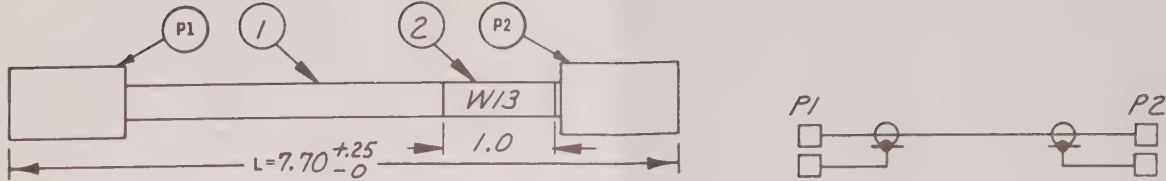
Figure 7.28. ECL Interface Cable Assembly (W10)

220967



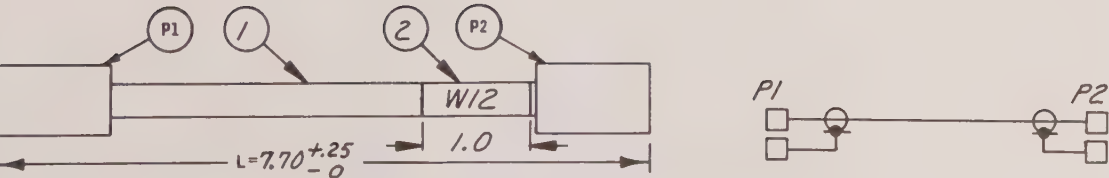
P2	1	84938	CONNECTOR, COAX	75Ω, SMB	51-128-9511	
P1	1	87372	CONNECTOR, COAX	75Ω, BNC	UBJ26-4	
2	.1FT	85219	TUBING, HEAT SHRINK		RT-876-WHT 1/4 DIA.	
1	.7FT	83156	CABLE, COAX	75Ω	8218	
ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
PARTS LIST						

Figure 7.29. Data Output Cable Assembly (W11)
220968A



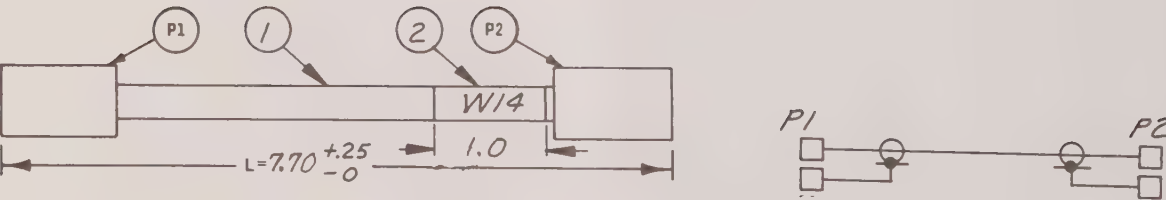
P2	1	84939	CONNECTOR, COAX	75Ω SMB	51-124-0000	
P1	1	87372	CONNECTOR, COAX	75Ω BNC	UBJ26-4	
2	.1FT	85219	TUBING, HEAT SHRINK		RT-876 WHT 1/4 DIA	
1	.7FT	83156	CABLE, COAX	75Ω	8218	
ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
PARTS LIST						

Figure 7.31. M-Sync Output Cable Assembly (W13)
220970A



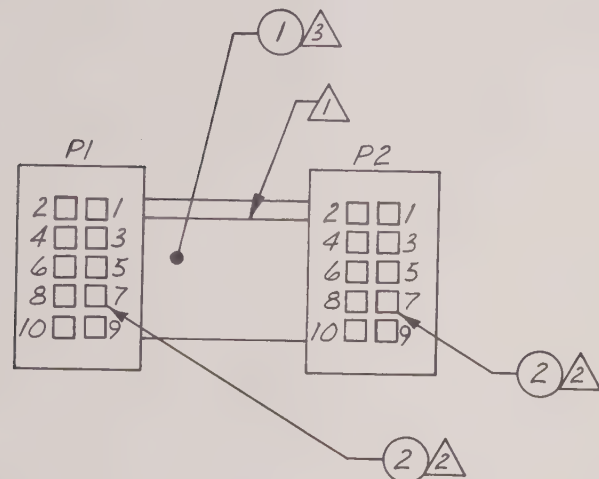
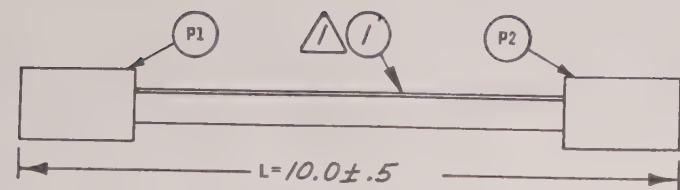
P2	1	84939	CONNECTOR, COAX	75Ω SMB	51-124-0000	
P1	1	87372	CONNECTOR, COAX	75Ω BNC	UBJ26-4	
2	.1FT	85219	TUBING, HEAT SHRINK		RT-876 WHT 1/4 DIA	
1	.7FT	83156	CABLE, COAX	75Ω	8218	
ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
PARTS LIST						

Figure 7.30. Clock Output Cable Assembly (W12)
220969A



P2	1	84939	CONNECTOR, COAX	75Ω SMB	51-124-0000	
P1	1	87372	CONNECTOR, COAX	75Ω BNC	UBJ26-4	
2	.1FT	85219	TUBING, HEAT SHRINK		RT-876 WHT 1/4 DIA	
1	.7FT	83156	CABLE, COAX	75Ω	8218	
ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
PARTS LIST						

Figure 7.32. Clock Input Cable Assembly (W14)
220971A



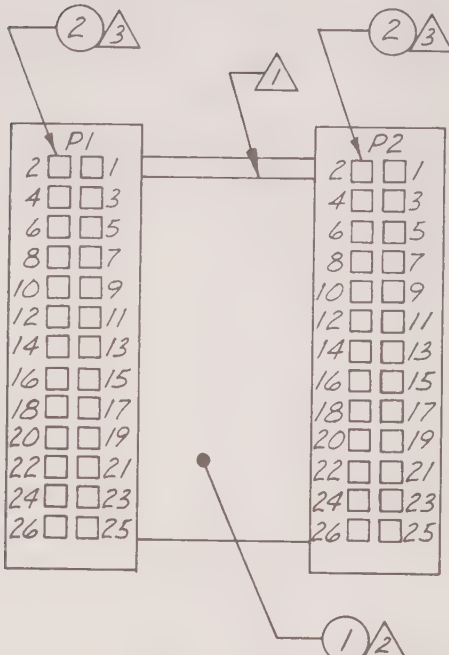
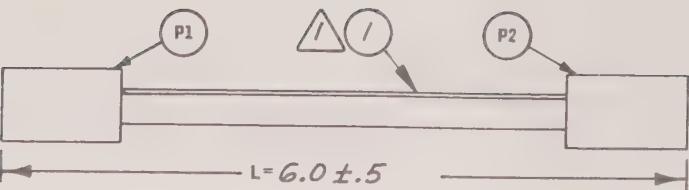
- NOTES:
- 1 RED LINE DENOTES PIN 1
 - 2 INSERT KEYING PLUG, ITEM 2, INTO PIN 7.
 - 3 PINS ON P1 CONNECTED TO IDENTICAL PINS ON P2.

2	2	83300	KEYING PLUG		86286-1	
P2	1	85048	CONNECTOR, 10 POS.		86981-2	
P1	1	85048	CONNECTOR, 10 POS.		86981-2	
1	.9FT	85130	CABLE, FLAT, 10 COND.	28 AWG	3365/10	
ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
PARTS LIST						

Figure 7.33. Front Panel Analog Interface (W15)

220956A

35G031Z



- NOTES:
- 1 RED LINE DENOTES PIN 1
 - 2 PINS ON P1 CONNECTED TO IDENTICAL PINS ON P2
 - 3 INSERT KEYING PLUG, ITEM 2 INTO PIN 2.

2	2	83300	KEYING PLUG		86286-1	
P2	1	85050	CONN., FLAT, 26 PIN	FEM.	86905-2	
P1	1	85050	CONN., FLAT, 26 PIN	FEM.	86905-2	
1	.6FT	82495	CABLE, FLAT, 26 COND.	28 AWG	3365/26	
ITEM OR FIND NO.	QTY REQD	S-A STOCK NO.	NOMENCLATURE OR DESCRIPTION	MATL SPEC AND SIZE OR COMPONENT VALUE	IDENTIFYING OR PART NO.	FSCM NO.
PARTS LIST						

Figure 7.34. Front Panel Digital Interface (W16)

220957A

CONVERSION OF VOLTAGE AND POWER RATIOS TO DECIBELS

The basic chart below indicates the number of decibels (dB) corresponding to the listed ratios of voltage or power over the range of -20 to +20 dB. For voltage or power ratios greater than those included in the chart, the ratio can be broken down into a product of two numbers, the value in dB for each found separately, and the two results added. Example: To convert a power

ratio of 2,000:1 to dB, express 2,000 as 2×10^3 ; the number of dB corresponding to a power ratio of 2 is very nearly 3, and the number of dB for a power ratio of 10^3 is 30. Therefore, the power ratio of 2,000:1 is approximately 30 dB + 3 dB = 33 dB. In the lower righthand corner of the chart dB values for voltage and power ratios of integral powers of 10 are given.

Voltage Ratio	Power Ratio	-dB +	Voltage Ratio	Power Ratio	Voltage Ratio	Power Ratio	-dB +	Voltage Ratio	Power Ratio	Voltage Ratio	Power Ratio	-dB +	Voltage Ratio	Power Ratio
1.000	1.000	0	1.000	1.000	.447	.200	7.0	2.239	5.012	.200	.0398	14.0	5.012	25.12
.989	.977	.1	1.012	1.023	.442	.195	7.1	2.265	5.129	.197	.0389	14.1	5.070	25.70
.977	.955	.2	1.023	1.047	.437	.191	7.2	2.291	5.248	.195	.0380	14.2	5.129	26.30
.966	.933	.3	1.035	1.072	.432	.186	7.3	2.317	5.370	.193	.0372	14.3	5.188	26.92
.955	.912	.4	1.047	1.096	.427	.182	7.4	2.344	5.495	.191	.0363	14.4	5.248	27.54
.944	.891	.5	1.059	1.122	.422	.178	7.5	2.371	5.623	.188	.0355	14.5	5.309	28.18
.933	.871	.6	1.072	1.148	.417	.174	7.6	2.399	5.754	.186	.0347	14.6	5.370	28.84
.923	.851	.7	1.084	1.175	.412	.170	7.7	2.427	5.888	.184	.0339	14.7	5.433	29.51
.912	.832	.8	1.096	1.202	.407	.166	7.8	2.455	6.025	.182	.0331	14.8	5.495	30.20
.902	.813	.9	1.109	1.230	.403	.162	7.9	2.483	6.166	.180	.0324	14.9	5.559	30.90
.891	.794	1.0	1.122	1.259	.398	.159	8.0	2.512	6.310	.178	.0316	15.0	5.623	31.62
.881	.776	1.1	1.135	1.288	.394	.155	8.1	2.541	6.457	.176	.0309	15.1	5.689	32.36
.871	.759	1.2	1.148	1.318	.389	.151	8.2	2.570	6.607	.174	.0302	15.2	5.754	33.11
.861	.741	1.3	1.161	1.349	.385	.148	8.3	2.600	6.761	.172	.0295	15.3	5.821	33.88
.851	.724	1.4	1.175	1.380	.380	.145	8.4	2.630	6.918	.170	.0288	15.4	5.888	34.67
.841	.708	1.5	1.189	1.413	.376	.141	8.5	2.661	7.079	.168	.0282	15.5	5.957	35.48
.832	.692	1.6	1.202	1.445	.372	.138	8.6	2.692	7.244	.166	.0275	15.6	6.026	36.31
.822	.676	1.7	1.216	1.479	.367	.135	8.7	2.723	7.413	.164	.0269	15.7	6.095	37.15
.813	.661	1.8	1.230	1.514	.363	.132	8.8	2.754	7.586	.162	.0263	15.8	6.166	38.02
.804	.646	1.9	1.245	1.549	.359	.129	8.9	2.786	7.762	.160	.0257	15.9	6.237	38.90
.794	.631	2.0	1.259	1.585	.355	.126	9.0	2.818	7.943	.159	.0251	16.0	6.310	39.81
.785	.617	2.1	1.274	1.622	.351	.123	9.1	2.851	8.128	.157	.0246	16.1	6.383	40.74
.776	.603	2.2	1.288	1.660	.347	.120	9.2	2.884	8.318	.155	.0240	16.2	6.457	41.69
.767	.589	2.3	1.303	1.698	.343	.118	9.3	2.917	8.511	.153	.0234	16.3	6.531	42.66
.759	.575	2.4	1.318	1.738	.339	.115	9.4	2.951	8.710	.151	.0229	16.4	6.607	43.65
.750	.562	2.5	1.334	1.778	.335	.112	9.5	2.985	8.913	.150	.0224	16.5	6.683	44.67
.741	.550	2.6	1.349	1.820	.331	.110	9.6	3.020	9.120	.148	.0219	16.6	6.761	45.71
.733	.537	2.7	1.365	1.862	.327	.107	9.7	3.055	9.333	.146	.0214	16.7	6.839	46.77
.724	.525	2.8	1.380	1.905	.324	.105	9.8	3.090	9.550	.145	.0209	16.8	6.918	47.86
.716	.513	2.9	1.396	1.950	.320	.102	9.9	3.126	9.772	.143	.0204	16.9	6.998	48.98
.708	.501	3.0	1.413	1.995	.316	.100	10.0	3.162	10.000	.141	.0200	17.0	7.079	50.12
.700	.490	3.1	1.429	2.042	.313	.0977	10.1	3.199	10.23	.139	.0195	17.1	7.161	51.29
.692	.479	3.2	1.445	2.089	.309	.0955	10.2	3.236	10.47	.138	.0191	17.2	7.244	52.48
.684	.468	3.3	1.462	2.138	.306	.0933	10.3	3.273	10.72	.137	.0186	17.3	7.328	53.70
.676	.457	3.4	1.479	2.188	.302	.0912	10.4	3.311	10.96	.135	.0182	17.4	7.413	54.95
.668	.447	3.5	1.496	2.239	.299	.0891	10.5	3.350	11.22	.133	.0178	17.5	7.499	56.23
.661	.437	3.6	1.514	2.291	.295	.0871	10.6	3.388	11.48	.132	.0174	17.6	7.586	57.54
.653	.427	3.7	1.531	2.344	.292	.0851	10.7	3.428	11.75	.130	.0170	17.7	7.674	58.88
.646	.417	3.8	1.549	2.399	.288	.0832	10.8	3.467	12.02	.129	.0166	17.8	7.762	60.26
.638	.407	3.9	1.567	2.455	.285	.0813	10.9	3.508	12.30	.127	.0162	17.9	7.852	61.66
.631	.398	4.0	1.585	2.512	.282	.0794	11.0	3.548	12.59	.126	.0159	18.0	7.943	63.10
.624	.389	4.1	1.603	2.570	.279	.0776	11.1	3.589	12.88	.125	.0155	18.1	8.035	64.57
.617	.380	4.2	1.622	2.630	.275	.0759	11.2	3.631	13.18	.123	.0151	18.2	8.128	66.07
.610	.372	4.3	1.641	2.692	.272	.0741	11.3	3.673	13.49	.122	.0148	18.3	8.222	67.61
.603	.363	4.4	1.660	2.754	.269	.0724	11.4	3.715	13.80	.120	.0145	18.4	8.318	69.18
.596	.355	4.5	1.679	2.818	.266	.0708	11.5	3.758	14.13	.119	.0141	18.5	8.414	70.79
.589	.347	4.6	1.698	2.884	.263	.0692	11.6	3.802	14.45	.118	.0138	18.6	8.511	72.44
.582	.339	4.7	1.718	2.951	.260	.0676	11.7	3.846	14.79	.116	.0135	18.7	8.610	74.13
.575	.331	4.8	1.738	3.020	.257	.0661	11.8	3.890	15.14	.115	.0132	18.8	8.710	75.86
.569	.324	4.9	1.758	3.090	.254	.0646	11.9	3.936	15.49	.114	.0129	18.9	8.811	77.62
.562	.316	5.0	1.778	3.162	.251	.0631	12.0	3.981	15.85	.112	.0126	19.0	8.913	79.43
.556	.309	5.1	1.799	3.236	.248	.0617	12.1	4.027	16.22	.111	.0123	19.1	9.016	81.28
.550	.302	5.2	1.820	3.311	.246	.0603	12.2	4.074	16.60	.110	.0120	19.2	9.120	83.18
.543	.295	5.3	1.841	3.388	.243	.0589	12.3	4.121	16.98	.108	.0118	19.3	9.226	85.11
.537	.288	5.4	1.862	3.467	.240	.0575	12.4	4.169	17.38	.107	.0115	19.4	9.333	87.10
.531	.282	5.5	1.884	3.548	.237	.0562	12.5	4.217	17.78	.106	.0112	19.5	9.441	89.13
.525	.275	5.6	1.905	3.631	.234	.0550	12.6	4.266	18.20	.105	.0110	19.6	9.550	91.20
.519	.269	5.7	1.928	3.715	.232	.0537	12.7	4.315	18.62	.104	.0107	19.7	9.661	93.33
.513	.263	5.8	1.950	3.802	.229	.0525	12.8	4.365	19.05	.102	.0105	19.8	9.772	95.50
.507	.257	5.9	1.972	3.890	.227	.0513	12.9	4.416	19.50	.101	.0102	19.9	9.886	97.72
.501	.251	6.0	1.995	3.981	.224	.0501	13.0	4.467	19.95	.100	.0100	20.0	10.000	100.00
.496	.246	6.1	2.018	4.074	.221	.0490	13.1	4.519	20.42					
.490	.240	6.2	2.042	4.169	.219	.0479	13.2	4.571	20.89		10 ⁻³	30		10 ³
.484	.234	6.3	2.065	4.266	.216	.0468	13.3	4.624	21.38		10 ⁻⁴	40	10 ²	10 ⁴
.479	.229	6.4	2.089	4.365	.214	.0457	13.4	4.677	21.88					
.473	.224	6.5	2.113	4.467	.211	.0447	13.5	4.732	22.39		10 ⁻⁵	50		10 ⁵
.468	.219	6.6	2.138	4.571	.209	.0437	13.6	4.786	22.91		10 ⁻⁶	60	10 ³	10 ⁶
.462	.214	6.7	2.163	4.677	.207	.0427	13.7	4.842	23.44		10 ⁻⁷	70		10 ⁷
.457	.209	6.8	2.188	4.786	.204	.0417	13.8	4.898	23.99		10 ⁻⁸	80	10 ⁴	10 ⁸
.452	.204	6.9	2.213	4.898	.202	.0407	13.9	4.955	24.55		10 ⁻⁹	90		10 ⁹
											10 ⁻¹⁰	100	10 ⁵	10 ¹⁰
											10 ⁻¹¹	110		10 ¹¹
											10 ⁻¹²	120	10 ⁶	10 ¹²

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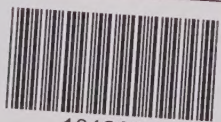
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